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The Journal of the Department of Agriculture of Victoria, Australia.

May, 1923.

PRINCIPAL CONTENTS

The Water Requirements of Farm Crops

Report on Stallion Registration

Citrus Fruit Export

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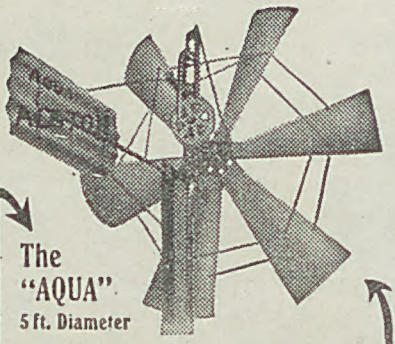

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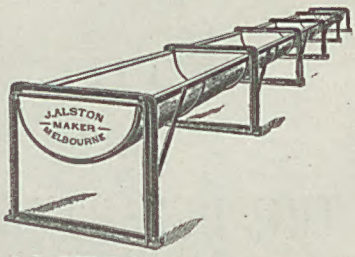

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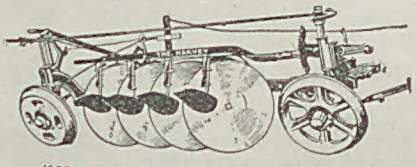

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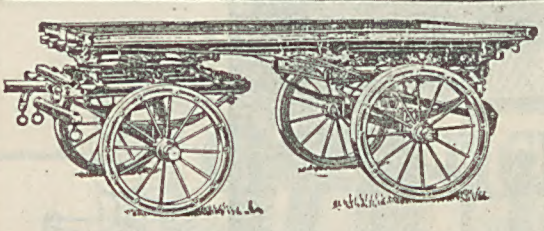

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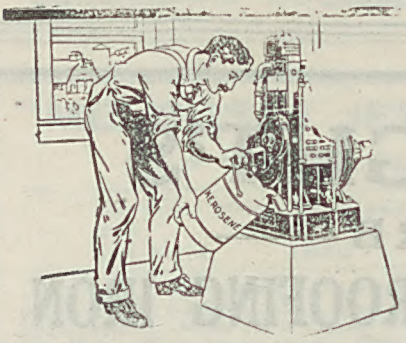

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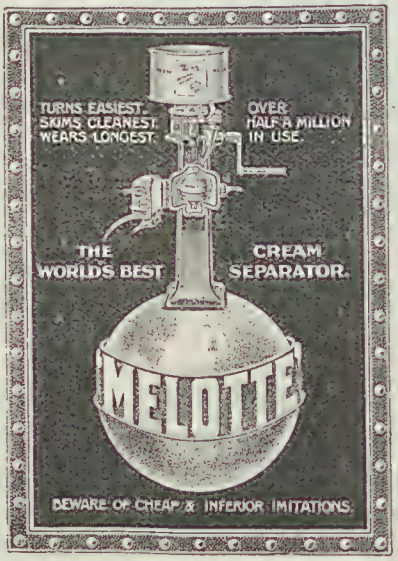

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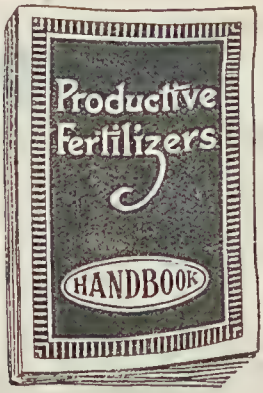

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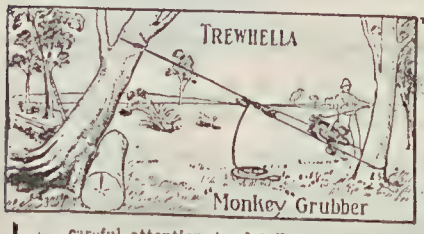

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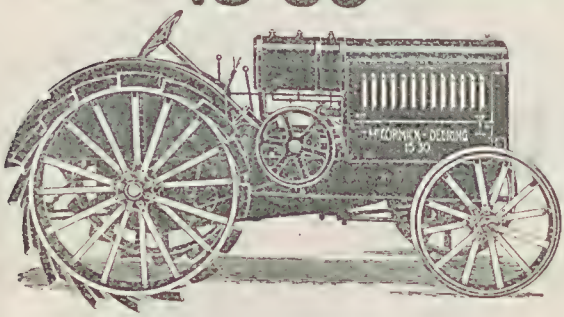

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Vol. XXI. **May, 1923.** **Part 5.**

WATER REQUIREMENTS OF FARM CROPS.

(Continued from page 212.)

By A. E. V. Richardson, M.A., B.Sc., Agricultural Superintendent.

Experiments in Pot Culture House, Rutherglen.

In the previous article the experiments conducted at Rutherglen and Werribee to determine the water requirements of various crops under field conditions were described.

During 1915 a series of experiments were commenced in a specially constructed pot culture hourse at Rutherglen. This house measured 24 feet by 20 feet, and consisted of a glass roof, gable shaped, 8 feet high at the sides and 13 feet in the centre. The sides were open and protected with blinds, which were only unrolled during showery weather. Along each side of the house a set of rails was laid, on which trolleys large enough to hold six standard pots were run. Two evaporometers were kept inside the pot culture house and two outside. In addition, a thermograph, maximum and minimum thermometers, wet and dry bulb thermometers, were placed within the glass-house, and a similar set of instruments was kept in an observatory screen in the field. Readings were taken daily throughout the year, and comparisons were thus available for crops growing inside the enclosure and in the open field outside.

The tests carried out in 1915-16 season comprised the following:—

A. Water requirements of farm crops.

B. Water requirements of different varieties of the same crop.

C. Effect of varying soil moisture content on the water requirements of wheat and lucerne.

D. Effect of varying fertilizers on the water requirements of wheat.

One hundred and thirty-two pots were used for this series of experiments, and each test was carried out in triplicate.

The pots used were 9 inches in diameter (internal measurement) and 20½ inches deep, and held about 60 lbs. of moist loam. The soil used in all tests except Series D (fertilizer tests) was a mixture of two parts river sand and one part of Rutherglen silt loam.

A frequent source of error in transpiration experiments is the determination of losses by evaporation from the soil. The losses may be greatly reduced by forcing the crops to grow through openings in tight-fitting covers and closing the space between the plant and the opening with wax seals.

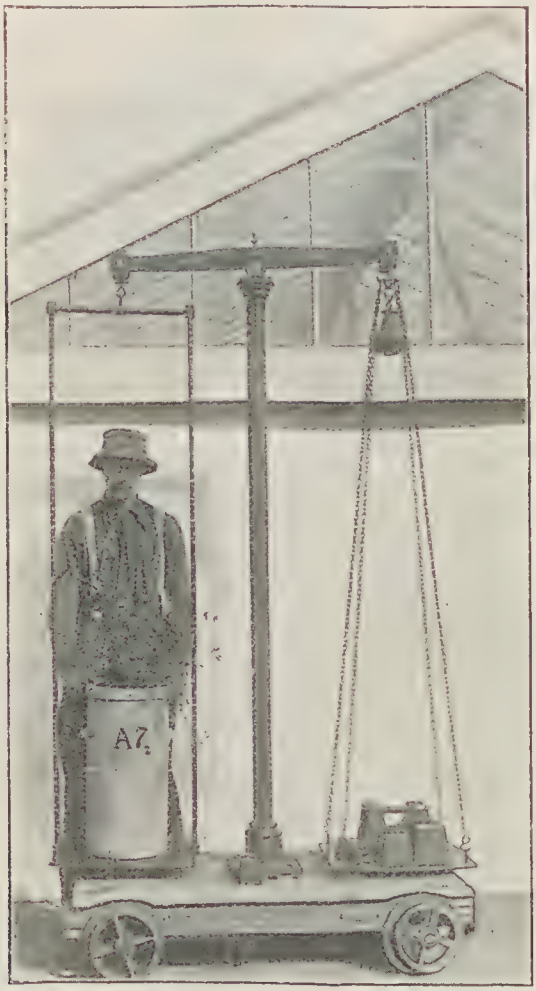


Fig. 9.—Scales used for weighing pots in determination of water requirements of crops.

With the use of gravel mulches and subsoil watering devices, the losses by evaporation may be reduced to very small proportions, and the losses by evaporation from the soil are very small in comparison with losses by transpiration. In all the experiments conducted in the pot culture house, water was added through watering tubes of perforated zinc, 16 inches long, tapering from 1 inch in diameter at the top to half an inch at the bottom. The tubes were fitted with linen covers to assist in the uniform and regular distribution of water to the soil. The

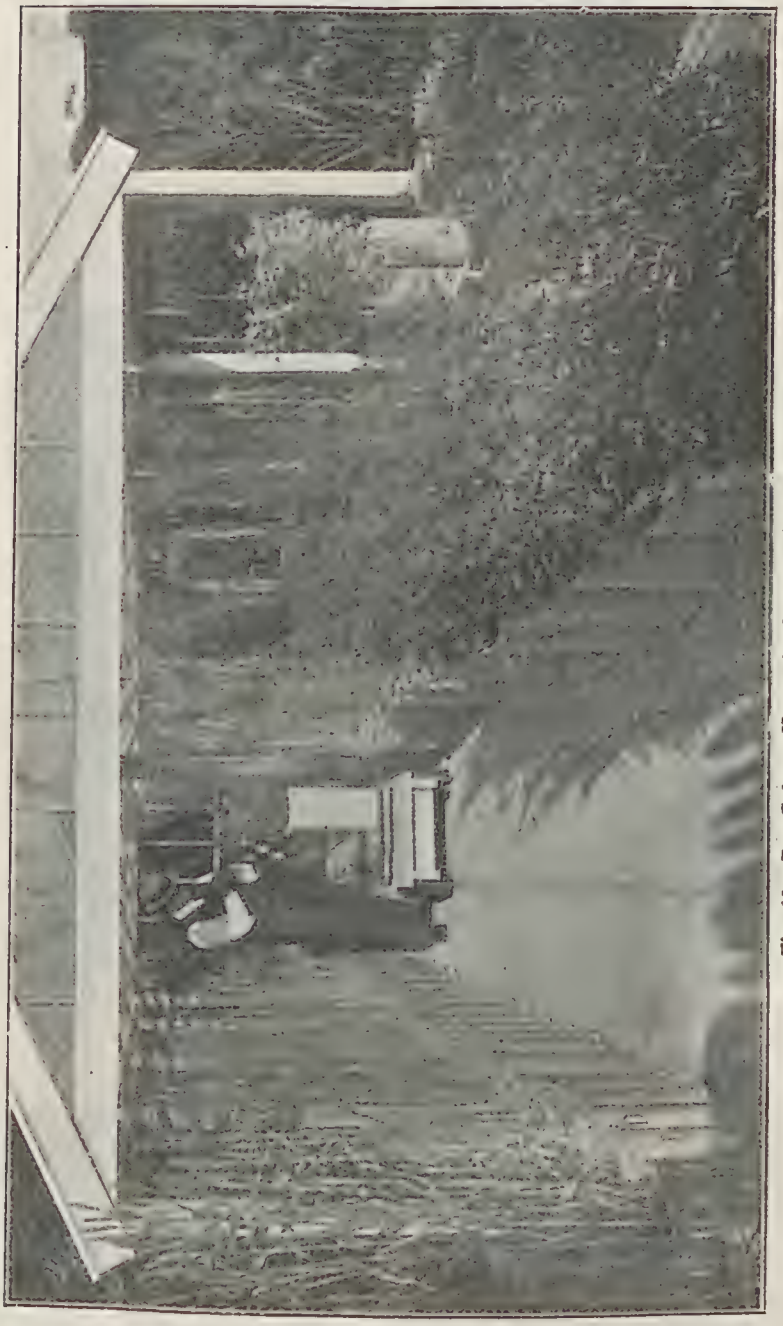


Fig. 10.—Pot Culture House, Rutherglen Experiment Farm.

watering tubes were plugged with corks, and the upper two inches of each tube had a tin band soldered round it.

Gravel mulches 2 inches in depth (gravel three-sixteenths to a quarter of an inch diameter) covered the soil of each pot.

The losses of water from fallow pots were found to be very small in comparison with the losses by transpiration, and were taken to represent the losses by evaporation from the soil surface.

The method of filling the pots was as follows.—40 lbs. of stock soil was added to each pot and the soil tamped down to a uniform volume. The watering tubes were placed in position in the centre of the pot, with the top of the tube flush with the top surface of the pot. Twenty pounds of soil was added and uniformly tamped. Five pounds of sifted

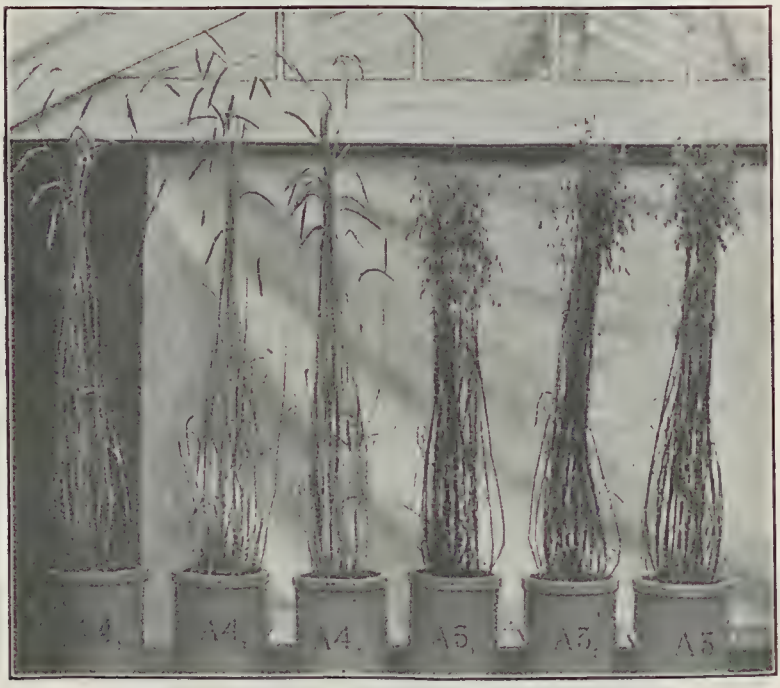


Fig. 11.—A Series—Water Requirements of Crops.
Pots showing growth of Rye ($A4_1$, $A4_2$, $A4_3$) and Oats ($A3_1$, $A3_2$, $A3_3$) at Rutherglen.

soil was then mixed with 1 gram $NaNO_3$, $\frac{1}{2}$ gram of superphosphate, and $\frac{1}{4}$ gram K_2SO_4 and added to each pot. Three seeds were then sown and pressed in $\frac{1}{4}$-inch deep. Six pounds of washed and sifted gravel was added to each pot to serve as a mulch. Water was then added through the watering tubes to bring the soil moisture content to the desired limit. The crops were sown at the normal seeding time for the district. During the early stages when transpiration losses were small, the pots were weighed weekly. When transpiration was active, the pots were weighed twice a week, except in Series C, where weighings were made each day. The weighing was carried out on a specially-constructed balance (Fig. 9) which turned with a load of 100 lbs. to one-twentieth of a lb.

A Series—Water Requirements of Various Types of Farm Crops.

Determinations were made of the water requirements of the following crops —wheat, barley, oats, rye, rape, peas, lucerne, beans, mustard, tares, wallaby grass, wild oats.

The following table summarizes the results:—

TABLE VII.

TRANSPIRATION RATIO FOR FARM CROPS GROWN IN POT CULTURE HOUSE, RUTHERGLEN EXPERIMENT FARM, SEASON 1915-16.

Crop.	Pot.	Water Transpired.	Dry Matter Produced.			Transpiration Ratio.	
			Straw.	Grain.	Total.	Whole Plant.	Grain.
		lbs.	grams.	grams.	grams.		
Wheat (Federation)	$A1_1$	59·33	82·70	36·78	119·48	225	748
	$A1_2$	65·36	85·69	38·23	123·92	239 } 231	779 } 755
	$A1_3$	46·78	63·68	28·61	92·29	230	742
Barley (Cape) ..	$A2_1$	72·24	76·50	57·20	133·7	245	573
	$A2_2$	67·84	78·36	54·50	132·86	232 } 237	565 } 558
	$A2_3$	71·70	78·23	60·53	138·76	234	537
Oats (Algerian) ..	$A3_1$	90·99	85·19	44·10	129·27	319	936
	$A3_2$	88·69	84·96	33·12	118·08	341 } 332	1215 } 1136
	$A3_3$	93·81	92·70	33·84	126·54	336	1257
Rye (Giant Winter)	$A4_1$	78·92	83·32	32·40	115·72	309	1105
	$A4_2$	81·41	92·18	27·13	119·31	310 } 320	1361 } 1191
	$A4_3$	81·98	76·79	23·55	109·34	340	1108
Rape, First Crop (Dwarf Essex)	$A5_1$	63·94	..	..	85·89	338	
	$A5_2$	65·70	..	..	97·77	305 } 322	..
	$A5_3$	63·55	..	..	89·23	323	
Rape, Second Crop	$A5_1$	61·28	..	..	78·65	353	
	$A5_2$	58·77	..	..	75·98	351 } 355	..
	$A5_3$	56·95	..	..	71·76	360	
Peas (Dun) ..	$A6_1$	86·05	72·73	72·44	145:17	269	539
	$A6_2$	83·57	68:77	65·95	134·72	281 } 283	575 } 571
	$A6_3$	94·31	71·69	71·69	143·11	299	599
Lucerne, seven crops (Hunter River)	$A7_1$	140·11	..	..	78·30	812 } 819	..
	$A7_2$	181·61	..	..	99·87	826	
Beans (Tick) ..	$A8_1$	63·93	34·22	45·66	79·88	363 } 380	635 } 688
	$A8_2$	70·65	37·78	43·22	81·00	396	741
Mustard (White) ..	$A8_3$	87·34	72·92	11·90	84·82	467 } 464	3329 } 4037
	$A9_3$	85·13	75·56	8·14	83·70	461	4744
Tares (Golden) ..	$A9_1$	72·66	30·53	13·09	43·62	756 } 721	2516 } 2314
	$A9_2$	86·55	38·70	18·60	57·30	685	2511
Wallaby Grass (*Danthonia*)	$A10_1$	32·03	..	..	39·71	366 } 363·5	..
	$A10_2$	33·54	..	..	42·04	361	
Wild Oats (*A. fatua*) ..	$A11_1$	47·99	..	..	92·51	235	
	$A11_2$	56·32	..	..	109·99	232 } 237	..
	$A11_3$	53·84	..	..	110·62	243	

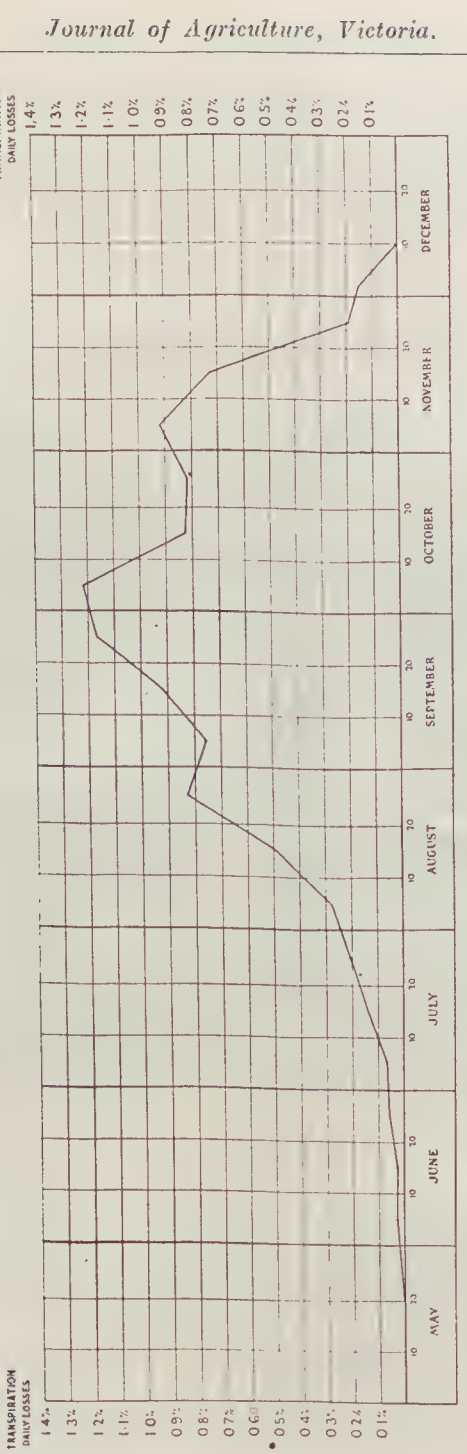


Fig. 12.—March of Transpiration for Wheat Expressed as Percentages of Total Transpiration.

The average Transpiration Ratios for crops grown in the culture house were approximately the same as those recorded under field conditions during the same season. Thus, the average Transpiration Ratio of five crops tested—wheat, barley, oats, rape, peas, grown in the culture house —was 284, whilst the average for the same crops grown under field conditions was 281.

The high roof and open sides of the pot culture house permitted free circulation of air, and, on the whole, gave atmospheric conditions very similar to those obtaining in the field. The protection from rain afforded by the pot culture house not only enabled the evaporation from the soil to be reduced to a minimum, but it also enabled the pots to be maintained throughout the whole of the growing period under more or less constant conditions as regards degree of soil saturation.

Fig. 13.—A Series—Water Requirements of Crops.
Wallaby grass (A10); Cape Barley (A2); Algerian Oats (A3); Giant Winter Rye (A4); Federation Wheat (A1); Hunter River Lucerne (A12).

For the control of experiments involving the determination of the water requirements of crops under varying degrees of moisture saturation, protection from rain is essential. The average temperatures under the culture house were found to be slightly higher than the temperatures recorded outside, but, on the other hand, the average humidity was greater. The evaporation from a free-water surface was slightly lower inside the house than in the field outside. For October, 1915, the month of maximum transpiration, the evaporation in the culture house was 3.61 inches, as compared with 3.54 inches in the field. The evaporation for the three months, September, October, and November, was 10.95 inches within the house and 12.43 inches outside. We may

assume, therefore, that the Transpiration Ratios for crops grown in the culture house will be closely parallel to, although slightly lower than, those for the same crops grown under field conditions.

The results for 1915 show that, in a season favorable for crop production, the Transpiration Ratios for winter-grown crops are relatively low.

Barley and wheat gave much lower Transpiration Ratios for dry matter and grain than either oats or rye, but peas showed the lowest water requirement of all crops tested.

The native Wallaby Grass (*Danthonia*) has a higher water requirement for dry matter than any of the cereals. Compared with all other crops tested, lucerne has a high Transpiration Ratio, the average for the season (seven cuts) being 819.

The water requirement of lucerne varied with the season of the year at which it was cut. The crops harvested during spring gave a lower water requirement as compared with crops harvested in summer or early autumn.

Fig. 14.—Water Requirements of Different Varieties of Wheat.
(*a*) Kubanka. (*b*) Huguenot. (*c*) Yandilla King. (*d*) Federation.

The duplicate pots show a fairly close agreement for the Transpiration Ratios for dry matter, but exhibit considerable fluctuations in the percentage of grain to total dry matter. Hence the Transpiration Ratios for grain show a wider range of variation than the Transpiration Ratios for dry matter. With any given crop the Transpiration Ratio for dry matter is much more constant than the Transpiration Ratio for grain.

The march of transpiration for wheat grown in the pot culture house during 1915 is shown graphically in Figure 12. In this graph

the losses by transpiration are shown in 10-day periods throughout the growing period of the crop. The daily losses by transpiration increased rapidly from the middle of August to the first ten days in October, when the daily losses were at a maximum. Transpiration was very active in October, but fell rapidly during November with the translocation of the elaborated materials from the straw and the ripening off of the crops.

The transpiration graph for wheat was plotted from the average daily losses by transpiration of the wheats grown in the C2 Series (described later), in which the pots were weighed daily and maintained throughout growth at a uniform moisture content equal to 45 per cent. of saturation.

These losses throughout the period of growth are summarized in the table hereunder.

TABLE VIII.

DAILY TRANSPIRATION AND TRANSPIRATION LOSSES FOR TEN-DAY PERIODS WITH WHEAT UNDER POT CULTURE CONDITIONS FROM SEEDING TO HARVEST EXPRESSED AS PERCENTAGES OF THE TOTAL WATER TRANSPIRED.—SEASON 1915-16.

Period.		Days.	Water Transpired.	Average Daily Losses.	Percentage Transpired during Period.	Loss per Calendar Month.
			lbs.	per cent.	per cent.	per cent.
May	5–25	20	·36·	·018	·370	..
	25–31	5	·18	·036	·18	·55
June	1–10	10	·30	·03	·30	..
	10–20	10	·30	·03	·30	..
	20–30	10	·58	·06	·59	1·19
July	1–10	10	·70	·07	·71	..
	10–20	10	1·40	·14	1·42	..
	20–31	11	2·31	·21	2·33	4·46
August	1–10	10	2·80	·28	2·83	..
	10–20	10	4·74	·49	4·88	..
	20–31	11	8·97	·83	9·08	16·79
September	1–10	10	7·75	·76	7·64	..
	10–20	10	9·04	·92	9·15	..
	20–30	10	11·60	1·17	11·72	28·51
October	1–10	10	12·04	1·22	12·20	..
	10–20	10	8·24	·83	8·33	..
	20–31	11	8·87	·82	8·98	29·51
November	1–10	10	9·09	·92	9·19	..
	10–20	10	7·23	·73	7·31	..
	20–30	10	1·90	·19	1·92	18·42
December	1–4	4	·58	·15	·59	·59
			98·82	..	100·02	99·65

The march of transpiration for barley and oats was similar to that of wheat, except that the period of maximum transpiration for oats occurred during November.

In the A series of tests, in which barley, wheat, and oats were grown under similar conditions, the time of maximum transpiration was found to be October 10-20 for wheat and barley, and November 1 to 10

for oats. The amount of water transpired during ten days of maximum activity and during the month of maximum transpiration in 1915 was as follows:—

Crop.	Percentage of Total Water Transpired.	
	During 10 days of Maximum Transpiration (October 10–20).	During Calender Month of Maximum Transpiration.
	%	%
Wheat	12·5	33·4 (October)
Barley	14·3	38·5 (October)
Oats	12·0	33·6 (November)

The three cereals showed close agreement as to relative amount of water transpired during ten days and during a calendar month of maximum activity during 1915. Transpiration at this period, however, was slightly greater with barley than with wheat and oats. The transpiration graph for cereals grown in the pot culture house during 1915 was somewhat similar to the graphs shown, for crops grown under field conditions in the drought year, except that the growing season was more prolonged and transpiration was less intense during October, 1915, than in October, 1914.

Though in a normal year the growing period of these crops is about seven months, approximately one-third of the total water transpired was used during one month, in season 1915, by oats and wheat, and nearly 40 per cent. by barley. With wheat, 76 per cent. of the total water required is used during the three months, September, October, and November. The march of transpiration for a perennial forage crop such as lucerne differs materially from that of annual grain crops. Transpiration increases steadily to a maximum at the time of cutting. This is brought out very clearly in the table showing the losses from the second, third, and fourth cuttings of a lucerne crop, in three-day periods, expressed as percentages of the total water used.

Table IX.

Showing March of Transpiration for Lucerne in Three-Day Periods Expressed as Percentages of Total Water Used.

Successive three-day period.	Water transpired in successive three-day periods.			Percentage of water transpired in three-day periods.		
	2nd cut.	3rd cut.	4th cut.	2nd cut. Oct. 14th–Nov. 22nd	3rd cut. Nov. 22nd. Dec. 13th	4th cut. Dec. 13th. Jan. 3rd.
	lbs.	lbs.	lbs.			
1	·52	·34	·86	1·1	1·1	2·6
2	1·2	1·34	1·86	2·5	4·2	5·5
3	1·33	2·03	2·90	2·8	6·3	8·6
4	1·22	5·54	4·10	2·5	17·3	12·2
5	1·82	4·89	8·85	3·8	15·3	26·4
6	3·40	8·46	7·49	7·1	26·5	22·3
7	3·77	9·37	7·50	7·9	29·3	22·3
8	4·55	..	..	9·5	..	..
9	4·79	..	..	10·0	..	..
10	6·22	..	..	13·0	..	..
11	5·18	..	..	10·8	..	..
12	6·91	..	..	14·4	..	..
13	6·97	..	..	14·6	..	..
	47·88	31·97	33·56	100·0	100·0	99·9

The time taken to bring a crop of lucerne to the stage at which it is harvested for hay (beginning of flowering) varied with the time of the year. During December and January, growth was rapid and the crop ready for cutting in 21 days. During October and November the lucerne required 39 days to reach the same stage of maturity. During the summer a lucerne crop at the maximum activity will transpire nearly 30 per cent. of the total water required to mature a hay crop in a three-day period.

Lucerne uses relatively large quantities of water compared with other farm crops. During winter and early spring it uses this water economically in the production of dry matter, but in midsummer the Transportation Ratio is often double or treble that of winter-grown lucerne. This point will be brought out more fully later.

Series B.—Water requirements of Different Varieties of Wheat.

A series of eighteen pots was sown with different varieties of wheat (in triplicate) to determine whether wheat varieties showed much variation in their ability to use soil moisture economically.

For this purpose three locally-bred wheats, Yandilla King, Federation, and Dart's Imperial, each of which has been widely grown in the Australian wheat belt, were selected, together with Indian 5, a variety with extremely short straw and considerable drought-resisting powers; Huguenot, and Kubanka, two typical Durum wheats. Three pots were kept under fallow as controls.

The results are summarized in the following table:—

Table X.

Water Transpired, Dry Matter Produced, and Transpiration Ratio for Dry Matter and Grain for Six Varieties of Wheat.

Variety.	Species.	Water transpired and evaporated	Water evaporated.	Water transpired.	Total dry matter, grain and straw.	Dry matter in grain.	Percentage of grain to dry matter.	Transpiration ratio for dry matter.	Transpiration ratio for grain.
		lb.	lb.		grams.	grams.	%		
Yandilla King ..	T. Sativum	55·06	5·24	49·82	108·03	34·21	31·7	209	660
Federation	„	64·29	„	57·39	111·90	34·54	30·9	231	752
Dart's Imp.	„	67·53	„	62·29	123·96	28·81	23·2	227	976
Indian 5	T. compactum ..	59·47	„	54·23	106·97	33·31	31·1	230	740
Huguenot	T. durum	63·29	„	58·05	107·08	25·61	23·9	243	1,081
Kubanka	„	61·33	„	56·09	106·52	21·52	20·2	238	1,188

The whole of the pots was maintained throughout the period of growth at a moisture content varying from 50 per cent. to 60 per cent. of saturation.

The results of the tests show that the varieties of wheat did not vary widely in regard to the quantity of water required to elaborate a unit of dry matter. The most efficient producer of dry matter was Yandilla King, with a Transpiration Ratio of 209, whilst the Transpiration Ratio for Huguenot was 243.

Whilst the Transpiration Ratio for dry matter was fairly constant with these varieties, the Ratio for grain produced showed wide differences, Yandilla King requiring 660 units of water to elaborate a unit of grain, as compared with 1,188 in the case of Kubanka.

The results of the tests are of importance in the breeding of wheat varieties for arid localities. For these dry areas it is very necessary

that the types chosen should produce a maximum yield of grain from a unit quantity of soil moisture. Yandilla King, Federation, and Indian 5 showed marked superiority in this respect over Huguenot and Kubanka. These three varieties gave an average percentage of grain to straw of 45.3, as compared with 28.3 per cent. in the case of Huguenot; or, expressing the grain in terms of dry matter, a percentage of grain to total dry matter of 31.7 per cent., as against 20.2 per cent.

Since the amount of water required to produce a unit of dry matter in any given season is fairly constant for most wheat varieties, it follows that the determination of the Transpiration Ratio is not essential for the selection of varieties suited for arid conditions.

A most useful criterion is the relative proportion of grain to straw—the migration ratio—for this is a measure of the efficiency of the plant

[Fig. 15.—C Series—Influence of Degree of Saturation on Water Requirements of Wheat.

C1, 37 %; C2, 45 %; C3, 60 %; C4, 75 %; C5, 90 % of Saturation.

for utilizing the limited supplies of soil moisture for grain production. Indeed, we find that when crops of the same variety are grown on soils of varying moisture content, the plants growing on the low-moisture content adjust their mode of growth to their environment and produce spare-stooling, short-strawed, narrow-leaved plants, bearing a relatively high proportion of grain and a relatively extensive root system. The same crop grown on a soil maintained at a high moisture content will be tall, leafy, and bear a lower percentage of grain to straw, and a relatively poor root system. Hence we may say that a high migration ratio is a factor of importance in the search for new varieties for arid districts, for this determines whether the Transpiration Ratio for grain will be low or high, or whether the variety will utilize the scanty water supplies economically or wastefully in the production of grain.

Series C.—Effect of Varying Moisture Content on the Water Requirements of Crops.

The effect of varying moisture content on the water requirements of both wheat and lucerne was determined by maintaining a series of pots growing wheat and lucerne at fixed degrees of soil saturation throughout the year. The degrees of saturation chosen were 30 per cent., 45 per cent., 60 per cent., 75 per cent., and 90 per cent. of the estimated water-holding capacity of the soil.

The pots were weighed weekly during June and July, when transpiration losses were very small, twice weekly during August, and daily from September till harvest. At harvest time the total crop from each pot was cut level with the surface of the ground. The soil from each pot was placed on a fine sieve, and the roots from each crop carefully separated by washing the soil away from the roots with a fine spray.

The roots were cut away from the small portions of straw left as stubble, and the "butts" of stubble were regarded as "overhead portion" of the crop. The following table summarizes the results:—

TABLE XI.

EFFECT OF VARYING DEGREES OF SOIL SATURATION ON PRODUCTION OF DRY MATTER, PERCENTAGE OF GRAIN TO STRAW, RATIO OF ROOTS TO OVERHEAD PORTION, AND TRANSPIRATION RATIO FOR DRY MATTER AND A GRAIN OF DART'S IMPERIAL WHEAT.—SEASON 1915-16.

Sown 1st May, 1915; Harvested 7th December, 1915.

Pot.	Saturation.	Total water lost.	Losses from check Fallow pots.	Water transpired.	Dry Matter in—			Percentage of Grain to Straw	Ratio Roots to overhead portion.	Transpiration Ratio for	
					Grain.	Straw.	Total.			Dry Matter	Grain.
		lbs.	lbs.	lbs.	grams.	grams.	grams.				
$C1_1$	30%	61·59	1·71	59·88	32·47	81·28	113·75	39·9	1 : 9·0	239, 231 — 235	837, 809 — 823
$C1_2$	30%	59·53	1·71	57·82	32·42	81·22	113·64	39·9			
$C2_1$	45%	82·83	3·98	78·85	35·61	109·21	144·82	32·6	1 : 11·1	247, 217, 212, 228 — 226	1004, 858, 884, 938 — 921
$C2_2$	45%	60·93	3·98	56·95	30·69	89·00	119·09	34·4			
$C2_7$	45%	73·18	3·98	69·20	35·51	112·33	147·84	31·6			
$C2_8$	45%	77·93	3·98	73·95	35·77	111·11	146·88	32·2			
$C3_1$	60%	93·94	4·40	89·54	33·32	126·63	159·95	26·3	12·7	254, 257 — 256	1220, 1069 — 1145
$C3_2$	60%	103·32	4·40	98·92	42·01	132·84	174·85	31·6			
$C4_1$	75%	75·60	4·70	70·90	25·63	117·15	142·78	21·9	1 : 15·9	225, 257, 250, 302 — 259	1255, 1203, 1591, 1533 — 1395
$C4_2$	75%	101·80	4·70	97·18	36·63	135·21	171·84	27·1			
$C4_7$	75%	31·77	4·70	27·07	7·72	41·32	49·04	18·8			
$C4_8$	75%	60·47	4·70	55·77	16·50	67·20	83·70	24·5			
$C5_1$	90%	31·77	6·35	25·42	5·14	24·65	29·78	20·8	1 : 18·8	380, 234 — 307	2253, 1594 — 1924
$C5_2$	90%	60·47	6·35	54·12	15·61	89·28	104·89	17·5			

The table brings out very clearly the following points:—

(1) The maximum yield of both straw and grain for wheat was obtained when the moisture content of the soil was maintained at 60 per cent. of the water-holding capacity.

The yield both of grain and straw declined as the degree of saturation was increased or diminished, but the decline in yield, particularly of grain, was more marked with high than with low degrees of saturation.

(2) The Transpiration Ratio for dry matter for wheat does not vary greatly with the degree of saturation, but, on the whole, the water requirement for dry matter is greater in a moist than in a dry soil,

and is lowest for a soil maintained at a moderate degree of soil humidity (45 per cent.).

(3) The water requirement for grain consistently and markedly increases as the degree of soil saturation increases, and with soil maintained at highest degrees of saturation the water cost for grain produced is more than double that associated with low saturation.

(4) The percentage of grain to straw was highest in the soil of low saturation, and the proportion of grain to straw consistently decreases with increasing soil saturation.

(5) The proportion of root to overhead development consistently diminishes with increasing soil saturation. The percentage of root to grain and straw is 11.1 per cent. in soil maintained at 30 per cent. of its water-holding capacity and only 5 per cent. in soil maintained at 90 per cent. of its water-holding capacity.

With the soil maintained throughout the period of growth at 30 per cent. of saturation, the percentage of grain to straw averaged 39.9 per

Fig. 16.—Effect of Varying Moisture Content on Water Requirements of Lucerne.
Pots maintained at, C1, 30%; C2, 45%; C3, 60%; C4, 75%; C5, 90% Saturation.

cent. With a soil maintained at 90 per cent. of saturation, the proportion of grain to straw fell to 19.2 per cent.

Not only is the water requirement for dry matter greater with high than with low soil humidity, but the proportion of grain to straw and total dry matter rapidly diminishes with increasing soil humidity, so that the Transpiration Ratio for grain rapidly increases with increasing soil saturation.

The wheat grown in these pots was of one variety—Dart's Imperial—and a pure line.

Obviously the character of the wheat, and particularly the proportion of grain to straw, varies considerably with the nature of the medium in which it is grown. The conditions obtaining in the pots kept at 30 per cent. of saturation are really comparable with those actually existing in arid regions, whilst the conditions in the pots maintained throughout the growing period at high saturation are really comparable with soils enjoying a high rainfall.

It will be observed that arid conditions, *i.e.*, the pots of low saturation (30 per cent.), produce plants with a high proportion (40 per cent.) of grain to straw. They also produce an extensive root system, the dry weight of which was 11.1 per cent. of the grain and straw produced. On the other hand, the humid soils, *i.e.*, pots maintained at 90 per cent. of saturation, produced plants with the lowest percentage of grain to straw (19.1 per cent.) and a comparatively meagre root system, the latter weighing only 5.3 per cent. of the grain and straw produced.

In the arid soil, Dart's Imperial wheat produces plants characterized by a high percentage of grain to straw, and a relatively extensive root system. In humid soil the plants are characterized by a very low percentage of grain to straw and a poorly-developed root system.

Table XII.

Effect of Varying Soil Saturation on the Transpiration Ratio of Lucerne.

Degree of Soil Saturation.	First Cut (111 days).	Second Cut (39 days).	Third Cut (21 days).	Fourth Cut (22 days).	Fifth Cut (21 days).	Sixth Cut (25 days).	Seventh Cut (30 days).	Eighth Cut (50 days).	Transpiration Ratio for Season.
30 per cent. (C1) ..	612	644	605	1252	1143	1164	1046	1087	885
45 per cent. (C2) ..	565	626	596	1190	1126	1163	1055	1000	808
60 per cent. (C3) ..	540	550	566	1142	1065	1191	973	860	753
75 per cent. (C4) ..	534	592	624	1315	1172	1293	1109	928	801
90 per cent. (C5) ..	512	593	919	1921	1294	905	1137	*	†756
Average for each cut	552	601	661	1364	1160	1143	1064	969	801
Evaporation from free water surface during each period of growth (inches) ..	4·01″	5·97″	5·50″	6·90″	6·94″	7·89″	7·65″	7·27″	52·13″

* Plants died. † Average for seven cuts only.

Varying degrees of soil saturation do not appear to have any marked effect on the Transpiration Ratio for lucerne. On the whole, lucerne grown on soils maintained at a moderate degree of soil saturation (60 per cent. of the maximum water-holding capacity) gave the lowest water requirement. The Transpiration Ratio increased as the soil saturation increased or diminished from 60 per cent. of saturation. With the highest degree of soil saturation (90 per cent.) the lucerne grew well and used water efficiently only when the plants were young and the root system was developing. The plants gradually weakened, and showed abnormally high Transpiration Ratios for the third and fourth cuts. During January the plants in one pot died, and those in the other pots became so stunted that water was withheld until they recovered.

The plants in $C5_4$ apparently had a low water requirement, but this was due to the fact that the bulk of the dry matter was produced early in the year when the Transpiration Ratios were low. The average Transpiration Ratio for the season, based on total water used to dry matter produced, was only 801, whilst the arithmetical mean of the separate Transpiration Ratios for each cut was 916.

It appears that lucerne gives the lowest water requirement with moderate degrees of saturation. When it is grown on soil maintained at either low or high degrees of saturation, the water requirement is increased and the yield of lucerne materially reduced. On May 8, after the final harvest was gathered, two pots from each series were used to determine the root development in each group of pots. The soil contained in the pots was emptied into a fine sieve and the roots separated by washing away the soil in a gentle stream of water.

The following table summarizes the results:—

TABLE XIII.

WEIGHT OF DRY MATTER IN ROOTS AND OVERHEAD PORTION OF LUCERNE GROWN IN SOILS MAINTAINED AT VARYING DEGREES OF SATURATION.

Degrees of Soil Saturation.	Weight of Dry Matter in Overhead Portion.	Weight of Roots.	Total Weight of Plant.	Ratio.	
				Roots.	Overhead Portion.
	grams.	grams.	grams.		
30%	102·38	30·87	143·25	1	3·3
45%	132·07	37·96	170·03	1	3·5
60%	139·17	23·50	162·77	1	5·9
75%	145·97	28·48	174·40	1	5·1
90%	49·48	6·16	55·64	1	8·0

With lucerne, as in the case of wheat, the proportion of roots to overhead matter diminishes with increasing soil saturation.

With the lower limits of saturation, *i.e.*, 30 per cent. of the water-holding capacity, 1 lb. of dry root is produced to every 3.3 lbs. of dry matter produced overhead. With a soil verging on saturation, *i.e.*, 90 per cent. of water-holding capacity, 1 lb. of dry roots is produced for each 8 lbs. of dry matter in the overhead crop.

There was a very marked development of fine roots of both lucerne and wheat in the pots maintained at 30 per cent. and 45 per cent. of saturation, as compared with the roots systems of these plants in the pots maintained at 75 per cent. and 90 per cent. of saturation. A photograph of the roots of wheat extracted from one pot maintained at 30 per cent. saturation is shown in Fig. 20, page 283.

The effect of varying degrees of soil saturation on water requirements of wheat and lucerne may be summed up as follows:—

(*a*) The Transpiration Ratio for dry matter is not materially affected by a variation in the degree of saturation except in the case of extreme conditions of saturation or dryness, in which case high Transpiration Ratios result.

(*b*) Both in the case of wheat and lucerne moderate degrees of soil saturation produce a lower Transpiration Ratio than high or low degrees of saturation.

(*c*) The water requirement for grain consistently increases as the degree of soil saturation increases.

(*d*) The percentage of grain to straw in wheat consistently decreases with the increasing soil saturation.

(*e*) Both with wheat and lucerne there is a marked and consistent increase in root development with decreasing soil saturation.

Series D.—Effect of Fertilizers on the Transpiration Ratio.

A series of tests was carried out to determine whether the addition of fertilizers influenced the Transpiration Ratio of wheat. The method adopted was to secure a naturally poor soil—a mixture of equal parts of beach sand and river sand—and to add various combinations of fertilizers—phosphoric acid, nitrogen, potash, lime—and to measure the effect of light and heavy dressings of each on the Transpiration Ratio. Beach sand from Carrum and river sand from Black Dog Creek, Rutherglen, were mixed in equal proportions. The air-dry mixed sample gave the following analysis:—

	Percentage.
Moisture	.208
Nitrogen	Trace
Phosphoric acid	.016
Potash	.020
Lime	.042
Magnesia	.023
Oxide of iron and alumina	.435
Chlorine	.004
Loss on ignition	.227

The actual water-holding capacity of the soil was determined to be 19.4 per cent. The real specific gravity was 2.64, the apparent specific gravity 1.667.

Fourteen series of pots, each series in triplicate, *i.e.*, 42 pots in all, were treated as follows:—

1. Control (no fertilizer).
2. Normal dressing of complete fertilizer (N, P, K, Ca).
3. No nitrogen, but normal dressing of P, K, Ca.
4. Excess of nitrogen and normal dressing of P, K, Ca.
5. No phosphoric acid but normal dressing of N, K, Ca.
6. Excess of phosphoric acid and normal dressing of N, K, Ca.
7. No potash, normal dressing of N, P, Ca.
8. Excess potash, normal dressing of N, P, Ca.
9. No lime, normal dressing of N, P, K.
10. Excess lime, normal dressing of N, P, K.
11. Excess of nitrogen and phosphoric acid, normal dressing of K and Ca.
12. Excess of nitrogen, phosphoric acid, and potash, normal dressing of lime.
13. Excess of nitrogen, phosphoric acid, and potash and lime.
14. Fallow—Control for determination of evaporation from the soil.

The dressings were arranged so that with each fertilizer there would be an excess of one fertilizer in one series of pots and a deficiency of that fertilizer in another.

The normal dressings for each fertilizer were as follows:—Nitrogen was applied as nitrate of soda at the rate of $\frac{1}{2}$ gram per pot, approximately 100 lbs. per acre. Phosphoric acid was applied at the rate of 1 gram of superphosphate (20 per cent. P_2O_5) per pot, *i.e.*, 200 lbs. superphosphate per acre. Potash, $\frac{1}{2}$ gram per pot, 100 lbs. per acre, and lime as calcium carbonate, 5 grams per pot, 1000 lbs. per acre.

The excess dressings were applied at the rate of ten times the normal dressings for each ingredient. Throughout the period of growth the pots were weighed weekly and brought to a constant weight of 108 lbs., which approximated 60 per cent. of water-holding capacity of the soil.

In spite of the poverty of the soil, the crop grown on some of the manured pots was exceptionally heavy and well developed. Even in the no-manure pot, the crop grew to maturity and formed some grain. At maturity the grain, straw, and roots from each pot were harvested. The roots were separated by emptying the soil from the pots on to a box-sieve of one-tenth-inch mesh and the sand washed through the sieve by means of a gentle stream of water.

The results are summarized in table on this page.

Effect of Fertilizers on the Yield.

The results show a remarkable variation in the yield of grain and straw with the various applications. The D_1 series of pots, though receiving no fertilizer, matured a crop of grain which, calculated on the area of the pot, was equivalent to 12.2 bushels per acre. The D_{13} series, fertilized with an excess of nitrogen, phosphoric acid, potash, and lime, gave a yield of 42.84 grams of grain per pot, equivalent to a yield of 122 bushels per acre. This result is explained by the fact that throughout the period of growth the soil in the pots was kept under optimum conditions of moisture saturation, *i.e.*, maintained at between 50 and 60 per cent. of water-holding capacity, which would be almost impossible of accomplishment under ordinary field conditions.

TABLE XIV.

EFFECT OF VARIOUS FERTILIZERS ON THE PRODUCTION OF DRY MATTER, TRANSPIRATION RATIO FOR DRY MATTER AND GRAIN, AND ON THE RELATIVE DEVELOPMENT OF ROOTS, STRAW, AND GRAIN OF WHEAT GROWN ON SAND.

Plots.	Treatment.	Water Transpired.	Dry Matter Produced.				Ratio.			Per cent. of roots to total weight of plant.	Transpiration Ratio.	
			Roots.	Grain.	Straw.	Total.	Roots.	Grain.	Straw.		Grain and Straw.	Grain only.
		lbs.	grms.	grms.	grms.	grms.						
D 1	No manure ..	12·77	2·09	4·28	11·12	17·49	1	1·12	6·0	11·2	377	1355
D 2	N, P, K, Ca (normal dressing)	25·58	4·25	9·54	32·59	46·39	1	2·24	7·6	9·2	292	1216
D 3	P, K, Ca—No Nitrogen	15·78	1·67	6·14	15·49	23·30	1	3·7	9·3	7·2	348	1178
D 4	P, K, Ca—Excess Nitrogen	51·43	3·99	21·88	57·80	83·67	1	5·4	14·4	4·8	302	1070
D 5	N, K, Ca—No Phosphoric Acid	25·42	3·25	9·39	30·16	42·70	1	2·9	9·3	7·6	306	1259
D 6	N, K, Ca—Excess Phosphoric Acid	28·97	3·95	10·13	37·12	51·20	1	2·6	9·4	7·7	278	1298
D 7	N, P, Ca—No Potash	28·02	3·01	10·08	35·14	48·23	1	3·3	11·6	6·2	292	1246
D 8	N, P, Ca—Excess Potash	27·96	3·15	11·56	35·26	49·97	1	3·7	11·2	6·3	283	1092
D 9	N, P, K—No Lime	26·04	3·29	9·01	31·18	43·48	1	2·8	9·4	7·6	311	1314
D 10	N, P, K—Excess Lime	27·86	3·69	10·62	33·92	48·23	1	2·9	9·4	7·7	296	1184
D 11	K, Ca—Excess Nitrogen and Phosphoric Acid	106·95	5·30	41·86	120·10	166·96	1	7·9	22·6	3·2	304	1160
D 12	Ca—Excess of Nitrogen, Phosphoric Acid and Potash	88·89	5·39	39·89	90·41	135·69	1	7·4	17·1	4·0	309	1012
D 13	Excess of Nitrogen, Phosphoric Acid, Potash and Lime	82·20	5·82	42·84	99·42	148·08	1	7·3	17·1	3·9	270	871

Let us examine the effects of the fertilizers on the yield of produce, the relative root development, the Transpiration Ratio, the composition of the plant, and the relative absorption of soil solutes.

1. Effect on Yield.

The influence of the various fertilizers on the relative yield of grain straw and total dry produce is illustrated in Fig. 17.

The application of a normal dressing of nitrogen, phosphoric acid, potash, and lime nearly trebled the yield of total dry matter. Nitrogen produced a greater effect on crop yields than any other treatment.

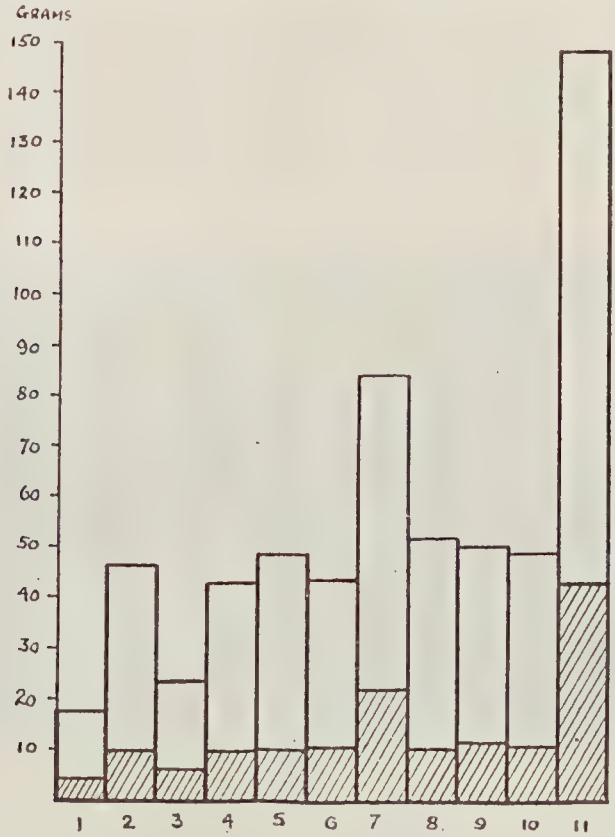


Fig. 17.—Effect of Deficiency and Excess of Various Fertilizers on Wheat Grown in Sand but Maintained at 50—60% Saturation.

1. No manure
2. Normal—N, P, K, Ca.
3. P, K, Ca—No N.
4. N, K, Ca—No P.
5. N, P, Ca—No K.
6. N, P, K—No Ca.
7. P, K, Ca—Excess N.
8. N, K, Ca—Excess P.
9. N, P, Ca—Excess K.
10. N, P, K—Excess Ca O.
11. Excess of N, P, K, Ca O.

Grain thus ..

When phosphoric acid, potash, and lime were added without nitrogen, the yield was only slightly greater than that of the manured plot. When nitrogen was applied in excess, the other nutrients being present as before, the crop yield (compared with the control) was more than qualrupled. In contrast with the effects of nitrogen, the application of excess quantities either of phosphoric acid, potash, or lime produced no

material increase in yield as compared with the plots receiving a normal dressing of these nutrients.

When excess of nitrogen and phosphoric acid were added the greatest total yield was obtained; but the highest actual yield of grain was obtained where an excess of all nutrients was used.

2. Effect on Root Development.

The effect of the fertilizers on the root system of wheat is marked. Where no manure was used no less than 11.2 per cent. of the total weight of the crop consisted of roots. Where all nutrients were applied in normal dressings 7.1 per cent. of the total weight of the crop consisted of roots. Finally, where excess dressings of all nutrients were applied the percentage of roots to total dry matter in the plant was only 3.9 per cent.

Fig. 18.—Influence of Fertilizers on Water Requirements of Wheat. View of Crops in early Spring.

Nitrogen appears to influence the relative proportion of roots to total dry matter to a greater extent than any other nutrient. An excess of either phosphoric potash or lime does not affect the percentage of roots compared with the corresponding controls. Where nitrogen is absent 7.2 per cent. of the weight of the crop consists of roots. Where nitrogen alone is in excess, the percentage of root falls to 4.8 per cent., and in no case where excess nitrogen is used with excess of other fertilizers does the percentage of roots exceed 4 per cent. We may, therefore, conclude that the application of fertilizers, and in particular the application of heavy dressings of nitrates, decreases the proportion of roots to total dry matter.

3. Effect of Fertilizers on Transpiration Ratio.

It is clear from these results that liberal applications of fertilizers have a material effect on the Transpiration Ratio.

Dressings of either nitrogen, phosphoric acid, potash, or lime lowered the Transpiration Ratio for dry matter as compared with the corresponding control plots in which these nutrients were absent.

Nitrogen produced the greatest relative reduction in the Transpiration Ratio for dry matter.

The unmanured controls produced crops with an average Transpiration Ratio of 377 for dry matter and 1355 for grain.

With normal dressings of nitrogen, phosphoric acid, potash, and lime the Transpiration Ratios were reduced to 292 for dry matter and 1216 for grain, compared with the unmanured control. With excess dressings of the same plant nutrients, the Transpiration Ratios were reduced to 270 and 871 for dry matter and grain respectively.

In other words, the unmanured controls gave a 29 per cent. higher water requirement than the normal dressing and a 39.6 per cent. higher water requirement than the complete heavy dressing. The Transpiration Ratios for grain for the unmanured controls were 11 per cent. and 55 per cent. higher than the corresponding ratios for a normal dressing and a complete heavy dressing.

Fig. 19.—Influence of Fertilizers on the Water Requirements of Wheat. View of Matured Crops.

(1) Untreated. (2) Normal Dressing of Fertilizer. (4) Excess of Nitrogen. (11) Excess of Nitrogen and Phosphoric Acid.

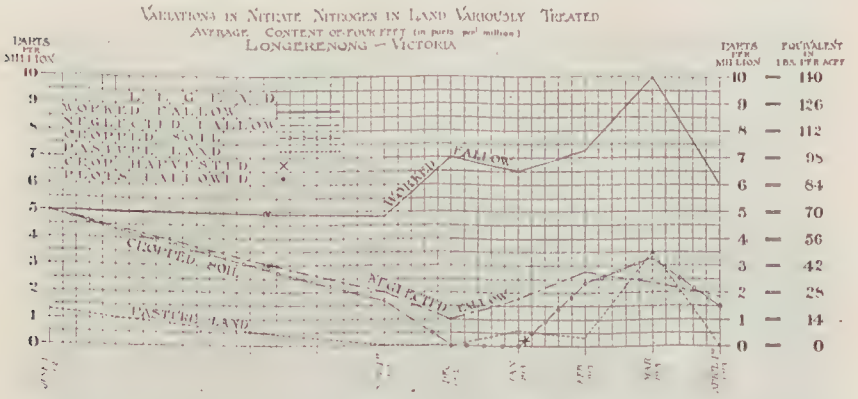
These results are of great practical significance. Fertilizers applied to soils, either naturally poor or deficient in any nutrient, not only greatly stimulate the yield, but appreciably lower the Transpiration Ratio for dry matter and grain.

The mineral constituent most lacking in Australian soils is phosphoric acid. Throughout the wheat belt of Australia the application of a relatively small amount of water soluble phosphoric acid, 60 to 100 lbs. per acre, has a most remarkable effect on the grain yield. On the other hand, nitrogen, although not abundant in our wheat soils, has little or no effect on the wheat yield. The explanation of this has been given in detail by the writer in a previous work (A. E. V. Richardson, "Wheat and its Cultivation," 1912). The wheat crop is usually preceded by a well-worked bare fallow. The aeration of the fallows as a result of frequent working, combined with the high moisture content of the

fallows and the favorable summer temperatures, lead to rapid nitrification of the organic matter of the soil, with the result that at seed time the amount of available nitrates present in the soil is sufficient for all possible demands of the wheat crop.

The writer showed in the Bulletin cited above that a well-worked fallow at Longerenong, Victoria, contained 91.9 lbs. of nitrate nitrogen at seed time, as compared with 21.0 lbs. in the non-fallowed land. In other words, the amount of nitrate nitrogen present in a well-worked fallow was more than four times as much as would be required by a 15-bushel wheat crop.

The following graph shows the fluctuation in the nitrate nitrogen content of the soil in well-worked fallow, neglected fallow, cropped soil, and pasture land during the summer and autumn months, on the Longerenong College Farm—a typical wheat area of Victoria.



Potash is present in abundance in the majority of Australian soils. Peaty and sandy soils alone show any response to potash manuring, and even on these the response to potash is only marked where root crops or legumes are grown. Lime is always present in quantities sufficient for the needs of crops, and is required in isolated cases only because of its effect on the soil texture and on soil acidity.

Phosphoric acid, however, is invariably the deficient mineral nutrient, and the limiting nutrient for crop production. Practical experience and field experiments have repeatedly demonstrated that only by the application of soluble phosphates can the wheat-grower secure the maximum yield the season and the soil will allow, and that the effect of phosphates is greater on fallowed than on stubble land.

The results of the tests described above suggest that, when nitrates are available in abundance (and in well-worked fallows a liberal supply of nitrates is assured), the addition of a soluble phosphate not only increases the vigour and size of the crop, but lowers the Transpiration Ratio and brings about a more effective use of the limited supplies of soil moisture.

4. Effect of Manures on Composition of Plant.

The roots, straw, and grain from two pots of each of the thirteen series were carefully harvested, and the percentage of nitrogen, phosphoric acid, and potash in the respective portions of each crop was determined. As the dry weight of root, straw, and grain produced from

each pot was known, the total amount of nitrogen, phosphoric acid, and potash taken in by the plant throughout the period of growth could be determined.

As the total water used in each series had already been determined, it was possible to calculate from this data the amount of water required to bring a unit weight of nitrogen, phosphoric acid, and potash into each of the thirteen series of crops.

The analyses of the crops from two representative pots of the whole series are summarized in the following table:—

Table XV.

Percentages of Nitrogen, Phosphoric Acid, and Potash in the Grain, Straw, and Roots of Wheat Grown on Sand, Treated with Various Fertilizers.

No. of Plot.	Nitrogen in—			Phosphoric Acid in—			Potash in—		
	Straw.	Grain.	Roots.	Straw.	Grain.	Roots.	Straw.	Grain.	Roots.
	%	%	%	%	%	%	%	%	%
Nil—									
$D1_1$	·266	1·59	·68	·060	·920	·483	1·468	·527	·221
$D1_2$	·242	1·63	1·01	·069	1·016	·401	1·350	·549	·200
Normal Dressing, N, P, K, Ca—									
$D2_1$	·215	1·39	·67	·047	·714	·322	1·336	·482	·661
$D2_2$	·242	1·34	·69	·059	·837	·312	1·250	·478	·580
Deficiency N—									
$D3_1$	·266	1·64	·97	·098	·996	·307	1·458	·583	·306
$D3_2$	·270	1·52	·69	·105	·957	·210	1·257	·563	·230
Excess N—									
$D4_1$	·566	2·88	1·07	·053	·479	·270	1·958	·374	·216
$D4_2$	·543	2·75	·99	·042	·450	·315	1·710	·359	·233
Deficiency P—									
$D5_1$	·266	1·35	·77	·083	·723	·315	1·397	·491	·250
$D5_2$	·269	1·49	·84	·078	·896	·395	1·590	·428	·220
Excess P—									
$D6_1$	·274	1·35	·76	·145	·939	·315	1·285	·531	·151
$D6_2$	·214	1·39	·70	·104	·980	·287	1·138	·442	·213
Deficiency K—									
$D7_1$	·196	1·34	·67	·106	·801	·311	1·019	·486	·262
$D7_2$	·143	1·38	·56	·132	·915	·271	1·500	·492	·204
Excess K—									
$D8_1$	·243	1·30	·88	·075	·759	·245	1·509	·508	·238
$D8_2$	·228	1·33	·70	·102	·852	·360	1·810	·463	·314
Deficiency CaO—									
$D9_1$	·266	1·32	·96	·133	·796	·250	1·536	·416	·311
$D9_2$	·242	1·40	·61	·100	·928	·287	1·470	·391	·281
Excess CaO —									
$D10_1$	·229	1·39	·76	·058	·754	·177	1·407	·433	·256
$D10_2$	·215	1·48	·60	·065	·530	·201	1·470	·521	·273
Excess N and P—									
$D11_1$	·376	1·68	·84	·160	·747	·305	1·289	·420	·394
$D11_2$	·314	1·63	·77	·100	·740	·250	1·080	·432	·340
Excess N, P, K—									
$D12_1$	·458	2·06	·76	·051	·528	·358	1·989	·356	·515
$D12_2$	·518	2·22	·92	·056	·598	·327	1·860	·389	·568
Excess N, P, K, CaO—									
$D13_1$	·402	1·76	·81	·054	·512	·390	1·785	·397	·589
$D13_2$	·382	2·06	·92	·048	·460	·337	1·847	·358	·517

Nitrogen has a greater influence on the composition of the plant than on other fertilizer applied. The application of heavy dressings of nitrogen produced marked increases in the nitrogen content of the straw in D11, D12, D13, and a great increase in D4 (where nitrogen was in excess in comparison with other nutrients).

Excess nitrogen produced a profound increase in the nitrogen content of the grain in Series D4, the grain of which averaged 2.81 per cent. of nitrogen, as compared with 1.61 per cent. of nitrogen in the unmanured controls, and 1.58 per cent. of nitrogen in the pots without nitrogen.

Substantial increases in the nitrogen content of the grain were obtained in D12, D13, D11, and the increases run parallel with the corresponding increases observed in the nitrogen content of the straw.

Heavy applications of phosphoric acid have only a slight effect on the composition of the straw and grain. A slight increase is observed in the phosphoric acid content of the grain, and a fairly substantial increase in the phosphoric acid content of the straw. The phosphoric acid content of the straw appears to vary with the relative proportions of potash, lime, and nitrogen applied.

If phosphoric acid is supplied to a soil deficient in either nitrogen, potash, or lime, the phosphate content of the straw is increased.

If phosphoric acid is added to soils well supplied with nitrogen, potash, and lime, the phosphate content of the straw is lowered.

Excess of nitrogen has a greater effect on the phosphate content of the grain than has phosphoric acid.

Without nitrogen, the grain averages .97 per cent. of phosphoric acid. With excess nitrogen the percentage of phosphoric acid in the grain is depressed to .46 per cent. With excess applications of all four nutrients the phosphate content remains at .48 per cent.—less than half the phosphoric content of the unmanured plots, or the plots without nitrogen. The straw of wheat is relatively rich in potash. Excess dressings of potash materially increase the potash content of the straw, but do not materially affect the potash content of the grain.

Excess nitrogen depresses the potash content of the grain, even in those cases where potash is present in abundance (D12, D13).

Excess of lime has the least effect of the four nutrients. It does not materially affect the percentages of nitrogen and potash content of the straw, grain, or roots, but slightly depresses the phosphate content of the plant, more especially of the straw and roots.

Looking at the results as a whole, the most significant changes in the composition of the plant are effected by nitrogen.

Heavy dressings of nitrates greatly increase the nitrogen content of the grain and straw of wheat. The increase in the nitrogen content of the grain is accompanied by a marked reduction in the phosphate content, and a lesser reduction in the potash content of the grain. Excess dressings of nitrogen also increase the potash content, and decrease the phosphoric acid content of the straw.

The actual weight of nitrogen phosphoric acid, and potash taken in by the roots, straw and grain of the crops from each manurial application is summarized in the following table:—

Table XVI.

Weights of Nitrogen, Phosphoric Acid, and Potash in the Grain, Straw, and Roots of Wheat Grown in Sand, Treated with Various Fertilizers.

No. of Plot.	Weight of Nitrogen in—				Weight of Phosphoric Acid in—				Weight of Potash in—			
	Straw.	Grain.	Roots.	Total Plant.	Straw.	Grain.	Roots.	Total Plant.	Straw.	Grain.	Roots.	Total Plant.
	grms.	grms.	grms.	grms.	grms.	grms.	grms.	grms.	grms.	grms.	grms.	grms.
Nil, N1												
D1 ..	·0334	·0696	·0171	·1201	·0075	·0403	·0122	·0600	·184	·0231	·0055	·2126
D1 ..	·0287	·0675	·0169	·1134	·0082	·0423	·0067	·0572	·160	·0229	·0033	·1862
Normal dressing N, P, K, Ca—												
D2	·0673	·1326	·0279	·2278	·0147	·0681	·0134	·0962	·418	·0460	·0275	·4915
D2	·0820	·1277	·0298	·2395	·0200	·0797	·0135	·1132	·428	·0455	·0251	·4986
Deficiency N—												
D3	·0393	·1086	·0130	·1609	·0145	·0660	·0041	·0846	·2156	·0386	·0041	·2583
D3	·0436	·0862	·0138	·1436	·0170	·0543	·0092	·0755	·2034	·0319	·0046	·2399
Excess N—												
D4 ..	·2985	·5322	·0653	·8960	·0279	·0885	·0106	·1270	1·0327	·0691	·0084	1·1102
D4 ..	·3413	·6952	·0404	1·0769	·0264	·1137	·0128	·1529	1·0749	·0907	·0095	1·1751
Deficiency PP—												
D8 ..	·0802	·1268	·0250	·2320	·0250	·0679	·0102	·1031	·4213	·0461	·0081	.4755
D8 ..	·0809	·1326	·0143	·2278	·0235	·0797	·0067	·1099	·4783	·0381	·0037	·5201
Excess P—												
D6 ..	·1019	·1351	·0316	·2686	·0540	·0940	·0131	·1611	·4781	·0531	·0063	·5375
D6 ..	·0793	·1148	·0262	·2203	·0385	·0809	·0107	·1301	·4215	·0365	·0079	·4659
Deficiency K—												
D7 ..	·0815	·1576	·0187	·2578	·0441	·0942	·0087	·1470	·4238	·0571	·0073	·4882
D7 ..	·0401	·1160	·0181	·1751	·0379	·0769	·0087	·1235	·4305	·0414	·0130	·4829
Excess K—												
D8 ..	·0931	·1598	·0296	·2825	·0287	·0934	·0082	·1303	·5779	·0624	·0080	·6488
D8 ..	·0735	·1440	·0206	·2381	·0328	·0923	·0106	·1357	·5832	·0501	·0092	·6425
Deficiency CaO—												
D9 ..	·0892	·1249	·0289	·2430	·0446	·0753	·0075	·1274	·5152	·0394	·0093	·5639
D9 ..	·0697	·1198	·0218	·2113	·0288	·0794	·0102	·1184	·4235	·0335	·0100	·4670
Excess CaO												
D10 ..	·0740	·1433	·0229	·2402	·0187	·0777	·0053	·1017	·4545	·0450	·0077	·5072
D10	·0763	·1625	·0261	·2649	·0238	·0582	·0087	·0907	·5220	·0572	·0118	·5910
Excess N + P												
D11 ..	·3895	·6635	·0412	1·0942	·1658	·2817	·0150	·4625	1·3354	·158	·0193	1·5127
D11 ..	·4289	·7403	·0439	1·2131	·1366	·3361	·0142	·4869	1·4753	·196	·0194	1·691
Excess N, P, K—												
D12	·4208	·8245	·0398	1·2852	·0469	·2117	·0187	·2773	1·8273	·143	·0269	1·9972
D12	·4607	·8822	·0509	1·3938	·0498	·2376	·0181	·3055	1·6544	·154	·0314	·1840
Excess N, P, K, Ca												
D13	·4002	·7939	·0466	1·2407	·0538	·2309	·0224	·3071	1·7743	·179	·0339	1·9872
D13	·3792	·8357	·0541	1·2690	·0476	·1866	0198	·2540	1·8335	·145	·0304	2·0099

The total intake of the mineral nutrients was thus determined, and as the water transpired throughout the whole period of growth was already known, it was possible to determine the amount of water required to bring in a unit weight of each mineral nutrient into the plant.

The amount of water required to bring into the plant a gram of nitrogen phosphoric acid and potash might be called the Transpiration Ratio for these nutrients. If these solutes were presented to the plant in a solution of unvarying concentration throughout the period of growth, the average concentration of the solutes in parts per million would range from 17 to 42 parts per million for nitrogen, 6 to 11 parts per million for phosphoric acid, and 36 to 54 parts per million for potash.

The amount of water required to bring into each series of crops a unit weight of nitrogen, phosphoric acid and potash, and the average concentration of the soil solutes for each manurial dressing are summarized in the following table:—

TABLE XVII.

TRANSPIRATION RATIO FOR NITROGEN, PHOSPHORIC ACID, AND POTASH, AND AVERAGE CONCENTRATION OF THE MINERAL INTAKE IN PARTS PER MILLION FOR WHEAT GROWN ON SAND AND TREATED WITH VARYING QUANTITIES OF NUTRIENTS.

Series.	Treatment.	Water transpired.	Transpiration Ratio.		Total Dry Matter.	Transpiration Ratio for—			Average concentration of mineral solutes in parts per million.		
			Straw and Grain.	Grain.		N.	P_2O_5.	K_2O.	N.	P_2O_5.	K_2O.
		lbs.			grms.						
D1	No manure	12·77	375	1348	17·49	47,680	94,790	27,900	21	10	36
D2	N, P, K, Ca—Normal dressing	25·58	292	1216	46·39	49,490	111,170	23,360	20	9	43
D3	P, K, Ca—No Nitrogen	15·78	348	1178	23·30	47,240	89,860	28,790	21	11	35
D4	P, K, Ca—Excess Nitrogen	51·43	302	1070	83·67	23,580	165,900	20,370	42	6	50
D5	N, K, Ca—No Phosphoric Acid	25·42	306	1259	42·70	50.070	108,250	23,180	20	9	43
D6	N, K, Ca—Excess Phosphoric Acid	28·97	278	1208	51·20	54,320	91,810	26,380	18	11	39
D7	N, P, Ca—No Potash ..	28·02	292	1246	48·23	58,270	92,730	26,070	17	11	39
D8	N, P, Ca—Excess Potash	27·96	283	1092	49·97	48,590	95,490	19,660	21	10	51
D9	N, P, K—No Lime ..	26·04	311	1314	43·48	52,170	96,080	23,090	19	10	43
D10	N, P, K—Excess Lime..	27·86	296	1184	48·23	49,910	132,120	22,980	20	8	43
D11	K, CaO—Excess Nitrogen and Phosphoric Acid	106·95	304	1160	166·96	42,130	102,200	30,320	24	10	33
D12	CaO—Excess Nitrogen, Phosphoric Acid, and Potash	88·89	309	1012	135·69	30,110	138,660	21,030	33	7	47
D13	Excess Nitrogen, Phosphoric Acid, Potash, and Lime	82·20	270	871	148·08	29,690	138,150	18,640	34	7	54

In the unfertilized soil the amount of water required to bring in a unit weight of nitrogen, phosphoric acid and potash is as follows:—

Nitrogen ..	...	...	47,680 parts water.
Phosphoric acid	...	...	94,790 ,, ,,
Potash ...	...	..	27,900 ,, ,,

This corresponds to an average concentration of the nutrients absorbed by the wheat throughout its growth, of 21 parts of nitrogen, 10 parts phosphoric acid, and 36 parts of potash per million parts of water, or a total of 67 parts of mineral nutrients per million parts of water absorbed and transpired. The most profound effect on the total concentration of the nutrient intake is brought about when nitrogen is present in excess quantities as compared with other nutrients. Where excess nitrogen is used (D4) the average concentration of the nitrogen intake is double (42 parts per million) that of the unmanured control, while the average concentration of the potash intake is increased to 50 parts per million. The total nutrient concentration for excess dressings

of nitrogen is 96 parts per million. On the other hand, excess dressings of phosphoric acid do not appear to materially affect the total nutrient intake, though the phosphoric acid intake is slightly increased and the

Fig. 20. -Roots of Wheat Plants Extracted from Pot Maintained Throughout Growth at 30% of Water-holding Capacity.

nitrogen intake decreased. Excess potash increases both the total nutrient intake and the proportion of potash absorbed, but, on the other hand, it lowers the proportion of phosphoric acid absorbed.

Comparing the D2 series of pots—a normal dressing of all nutrients—with the D14 series—excess dressing of all nutrients—it will be noted—

1. That the total nutrient intake is increased from 72 parts to 95 parts per million parts of water absorbed.
2. The proportion of nitrogen and potash is materially increased whilst the proportion of phosphoric acid is lowered.

The concentration of the intake does not necessarily reflect the average concentration of the soil solution in respect to these mineral nutrients, because different plants grown on the same soil would show very different relative values for intake of mineral nutrients because of the characteristic selective action, and varied requirements of each species of plant.

Moreover, there is reason to believe that the average concentration of the mineral intake during the early stage of a plant's growth may be higher than during the later stages. This is suggested from some results obtained in this Department by Robertson and Ramsay (Department of Agriculture, Victoria Bulletin No. 39) with potatoes. From a review of the analyses of a potato crop at different stages of maturity, it was shown that potatoes took up during the first fifty-eight days of growth approximately 75 per cent. of the nitrogen, phosphoric acid, and potash required, though during this period only one-half of the total dry matter had been formed. The period of maximum transpiration for farm crops, including potatoes, occurs when the plants approach the flowering stage. It would appear, therefore, that the potato crop must absorb less mineral nutrient and proportionately more water in the final stages of its growth. In view of these considerations, it does not seem possible to make use of the transpiration ratio, as Lyon and Bizzel (1913) have suggested, as a means of determining the relative density of the soil solution in different types of soil.

(*To be continued.*)

POTATO GROWING.*

We are in receipt of a copy of a little book on Potato Growing by Mr. Geo. Seymour. The work supplies much information regarding methods, together with numerous statistics bearing on the industry.

The author is a recognised authority on the subject, which is dealt with in a practical manner, and in terms which are easily understood by tyro and expert alike.

The publication deserves success, and should be of great interest and value to those engaged in the industry.

* *Potato Growing in Australia* (Whitcombe and Tombs Ltd., 189 Little Collins-street, Melbourne), 2s. 6d., posted 2s. 9d.

REGISTRATION OF STALLIONS,

Third Annual Report under the Horse Breeding Act 1919.

W. A. N. Robertson, B.V.Sc., Chief Veterinary Inspector.

During the past season, the third in which the Horse Breeding Act has been in operation, some degree of dissatisfaction was expressed at the provisions of the Act, and the pessimist—usually one who had had the misfortune to have a stallion rejected—has raised his voice loudly in complaint that the horse-breeding industry has been ruined.

The grounds upon which such an assertion is made are that alleged good horses which have been refused registration are being sent to adjoining States, that the type, especially amongst draughts, is deteriorating, and that stallion owners are being forced out of business.

If the Horse Breeding Act is indeed responsible, then the position in the adjoining States, where there is no legislation, ought to be very favorable and the industry be on a sound basis. Inquiry does not reveal that this is so, but rather the reverse, and those who are in a position to judge are seeking a means, in New South Wales at least, to improve the situation which has arisen, and are pressing for the introduction of legislation similar to that in operation in Victoria. Critics within our own boundaries, who discuss the question usually from personal rather than the national view-point, overlook one important consideration. The Act has been in operation for only three years. Consequently progeny, the result of matings during the first year the Act was in force, are only this season's two-year-olds. Therefore it must be some years before any valuable deduction can be made as to the effect the Act will have upon type of horses bred.

A general survey of the position may throw some light upon the matter, especially with regard to the alleged dearth of draught stallions in the State and what has been responsible for the shortage.

Consideration of the subject raises the question—What has become of the old school of draught-horse breeder, who took such a pride in breeding good stock? Some of them unfortunately have passed away. Many have retired from the business for one of two reasons. Quite a number, having acquired sufficient means on which to lead a quiet life, have left the country, and probably find a motor car the most convenient means of travelling. Others not so fortunate have ceased to keep a stallion, because during the war there was difficulty in obtaining reliable grooms, and because following boom periods draught horses were so plentiful that values fell to a point at which breeding became unprofitable. This fall in value was largely due to legislation not having been enacted earlier, whereby rejected stallions could have been put out of commission. Thus uncertificated stallions were standing at a low service fee, and so the keeping of a thoroughly sound stallion became much less profitable than it should have been.

These handicaps were undoubtedly the cause of some of the older school dropping out, and preferring a less troublesome old age, they now hesitate to re-enter the business.

We may next ask—Why has the succeeding generation not stepped into the breach? This may be answered largely by saying that the greater number have acquired properties of their own, and are not yet sufficiently well-established to give serious attention to the problem. They are content to assume that the risk of having a stallion rejected

after the first year's registration is too great for them to undertake. This leads us to a consideration of what is the risk.

In 1920-21 forty-six three-year-old draughts were granted certificates; the following year four of these were refused certificates as four-year-olds. In the same year fifty-four four-year-olds were registered, and as five-year-olds nine of them were turned down. In 1921-22 seventy-three three-year-olds were registered, and as four-year-olds six of them were last year refused registration, while of forty-five four-year-olds certificated in 1921-22 three were rejected last year.

It must, therefore, be admitted that there is a risk, but it is not nearly so formidable as the pessimist would have us believe, and that the risk is gradually being seen at its true value was indicated at the last stallion sales when practically every horse offered for sale changed hands at a satisfactory figure. As hereditary unsoundness is eliminated, the chance of loss will be minimized, if it does not totally disappear, with the enacting of legislation. But in order that owners who are unfortunate in this respect may be compensated, the Minister of Agriculture has promised that a Bill to provide for insurance against the non-certification of stallions will be brought down next session.

During the 1921-22 season the total number of stallions eligible for registration for which applications were lodged was 1,570, and last season the number was 1,748, an increase of 178. The number of draught horses examined in 1921-22 was 311, and last year 347, an increase of 36. This increase was more than accounted for by the number of three-year-olds brought forward, there being 134 as against 89 the previous year, an increase of 45. Such figures are a clear indication that horse-breeding is slowly and surely coming back into its own, and the gradual removal of rejected stallions, which brought about the collapse, is steadying the market and making the business of rearing horses a lucrative one to an increasing number of young men, who are willing to take the risk with the belief that ultimately Victoria's lead over other States will be firmly established.

Analyses of Rejections.

During last season 252 parades were conducted by examining officers. At these a total of 637 stallions was submitted for examination. Of this number 456 were pronounced sound and of approved type and were registered. As 1,109 over five years of age were registered without examination it means that last year 1,565 registrations were made. As in previous years the majority of horses examined were draughts. Of the 347 submitted, 83, or 23.9 per cent., were rejected, a fall of 8 per cent. from the previous year.

Thirty-six, or 10.3 per cent. of all the stallions presented, were rejected as being below a reasonable standard, while 47, or 13.5 per cent., were found unsound. This is an appreciable fall on the figures of the previous year when 19.6 per cent. were rejected on the ground of unsoundness.

The unsoundness mainly responsible for rejections in the case of draught horses was, as usual, sidebones, which accounted for 12.1 per cent., and here a satisfactory fall is noted from 16.7 per cent. in 1921-22. If such improvement can be maintained, it will not be many years before the risk in buying a draught horse will be negligible. The table hereunder shows the rejections for other forms of unsoundness, which are so light as not to call for comment Amongst light horses 21, or 11 per cent., were found unsound; bone spavin and ringbone were responsible

for the major portion. Of the hundred ponies examined, only one was found unsound, the unsoundness being due to ringbone.

TABLE SHOWING DETAILS OF EXAMINATIONS.

	Draught.		Light.		Pony.		Total.	
	Examined.	Certificated.	Examined.	Certificated.	Examined.	Certificated.	Examined.	Certificated.
	347	264	190	126	100	66	637	456
	Rejected.	Per cent. Rejected.	Rejected.	Per cent. Rejected.	Rejected.	Per cent. Rejected.	Rejected.	Per cent. Rejected.
Bog Spavin ..	..	..	2	1·05	..	..	2	·31
Bone Spavin ..	1	·28	8	4·21	..	..	9	1·41
Curb	..	..	3	1·57	..	..	3	·47
Ringbone ..	3	·86	7	3·68	1	1·00	11	1·72
Sidebone ..	42	12·10	..	..	..	..	42	6·59
Roaring ..	1	·28	1	·52	..	..	2	·31
Through unsoundness ..	47	13·54	21	11·05	1	1·00	69	10·83
Through disapproval ..	36	10·37	43	22·63	33	33·00	112	17·58
Total ..	83	23·91	64	33·68	34	34·00	181	28·41

Appeals.

Twenty appeals were lodged against the decisions of the veterinary officers. In each of nineteen of these cases the reason for rejection was, "disapproval—the horse was 'below standard.'" The remaining one combined the twofold basis for rejection, "unsoundness" and "below standard." The Boards appointed to consider the appeals upheld in eighteen cases the veterinary officer's decision, and in two reversed it and granted certificates.

Parades for Coming Season.

The time-table of parades for the coming season published on pages 287-292 has been arranged so that every centre in the State may if required be visited. Owners of stallions should study the schedule of parades, and having decided at which they will present their stallion, insert the name of that place in the space provided therefor in the form of application for registration.

It will not necessarily follow that because a parade is listed in the schedule that a veterinary officer will attend there. In fact, if no owner has notified his intention of presenting his horse there, an officer will not attend. If a parade be not held on the date set down, it may be impossible to arrange for a second one until after the season has opened, as the Veterinary Staff will be fully engaged right up to the time of the Royal Show.

Application for registration should be made before the 1st July, and if owners comply with all requirements the veterinary officers will be prepared to inform them of the result of the examination on parade day.

Forms of application may be obtained from secretaries of Agricultural Societies and from the officer in charge of all police stations, to whom I desire to again record my thanks for assistance during the past year.

All registrations except those made after the 1st April of this year automatically terminate on 30th June next. Owners should carefully note that if a stallion changes ownership in any way the registration will expire within thirty days, unless due notice is given and the certificate of registration suitably indorsed.

STALLION PARADES

TIME TABLE, 1923-24.

Provided that the applications for registration received indicate that a horse will be in attendance there for examination, a parade will be held at each of the following places :—

No. and Date.	Parade.	Time.	Officer Arrives.	Officer Departs.
No. 1.				
Monday, June 25 ..	Dunolly ..	1.41 p.m.	1.41 p.m. ..	3.35 p.m.
Monday, June 25 ..	Maryborough	4.30 p.m.	4.30 p.m. ..	10.18 p.m.
Tuesday, June 26 ..	Mildura ..	2 p.m. ..	8 a.m. ..	7.35 a.m. (27th)
Wednesday, June 27..	Ouyen ..	10 a.m. ..	9.55 a.m. ..	Driving
Wednesday, June 27..	Walpeup ..	12 noon ..	Driving ..	Driving
Wednesday, June 27..	Underbool ..	2 p.m. ..	Driving ..	Driving
Wednesday, June 27..	Tutye ..	3.30 p.m...	Driving ..	Driving
Wednesday, June 27..	Murrayville..	4.30 p.m.	Driving ..	Driving
No. 2.				
Monday, June 25 ..	St. Arnaud ..	3.30 p.m.	3.22 p.m. ..	12.9 a.m. (26th)
Tuesday, June 26 ..	Speed ..	9 a.m. ..	4.16 a.m. ..	11.1 a.m.
Tuesday, June 26 ..	Woomelang	11.53 a.m	11.53 a.m. ..	12.3 p.m. (27th)
Wednesday, June 27..	Watchem ..	1.30 p.m.	1.32 p.m. ..	6.52 p.m.
Thursday, June 28 ..	Curyo ..	9 a.m. ..	Driving ..	Driving
Thursday, June 28 ..	Birchip ..	11 a.m. ..	Driving ..	1.5 p.m.
Thursday, June 28 ..	Donald ..	2.30 p.m...	2.13 p.m. ..	5.55 a.m. (29th)
No. 3.				
Tuesday, June 26 ..	Sea Lake ..	10 a.m. ..	7.40 p.m. (25th)	Driving
Tuesday, June 26 ..	Nandaly ..	12 noon ..	Driving ..	Driving
Tuesday, June 26 ..	Kulwin ..	3 p.m. ..	Driving ..	Driving
Wednesday, June 27..	Culgoa (Railway Station)	9 a.m. ..	Driving ..	9.54 a.m.
Wednesday, June 27..	Wycheproof (Railway Station)	11.40 a.m.	11.40 a.m. ..	12.25 p.m.
Wednesday, June 27..	Charlton (Railway Station)	1.22 p.m.	1.22 p.m. ..	1.43 p.m.
No. 4.				
Tuesday, July 3 ..	Dimboola ..	9.30 a.m.	6.5 p.m. (2nd) ..	11.45 a.m.
Tuesday, July 3 ..	Rainbow ..	2.45 p.m...	2.45 p.m. ..	3.50 p.m.
Tuesday, July 3 ..	Yaapeet ..	4.40 p.m...	4.40 p.m. ..	5.30 p.m.
Wednesday, July 4 ..	Kaniva ..	2 p.m. ..	2.28 a.m. ..	12.42 a.m. (5th)
Thursday, July 5 ..	Jeparit (Railway Station)	10.8 a.m.	10.8 a.m. ..	10.55 a.m.
Thursday, July 5 ..	Lorquon (Railway Station)	11.50 a.m.	11.50 a.m. ..	12.5 p.m.
Thursday, July 5 ..	Yanac (Railway Station)	1.20 p.m...	1.20 p.m. ..	1.40 p.m.
No. 5.				
Tuesday, July 3 ..	Goroke ..	3 p.m. ..	1.15 p.m. ..	6 p.m.
Wednesday, July 4 ..	Horsham ..	9 a.m. ..	9.5 p.m. (3rd) ..	5.50 p.m.
Thursday, July 5 ..	Natimuk ..	10 a.m. ..	7 p.m. (4th) ..	Driving
Thursday, July 5 ..	Toolondo ..	12 noon ..	Driving ..	Driving

STALLION PARADES, TIME TABLE—*continued.*

No. and Date.	Parade.	Time.	Officer Arrives.	Officer Departs.
No. 6.				
Tuesday, July 3 ..	Hopetoun ..	11 a.m. ..	9.40 p.m. (2nd)..	7.20 a.m. (4th)
Wednesday, July 4 ..	Warracknabeal	2 p.m. ..	10 a.m. ..	7.30 p.m.
Thursday, July 5 ..	Beulah ..	9.30 a.m...	9.20 p.m. (4th)..	11.45 a.m.
Thursday, July 5 ..	Minyip ..	3.15 p.m...	3.10 p.m. ..	11.45 a.m. (6th)
Friday, July 6 ..	Murtoa (Railway Station)	12.35 p.m.	12.35 p.m. ..	1.10 p.m.
No. 7.				
Monday, July 2 ..	Ballan ..	10.15 a.m.	10 a.m. ..	12.2 p.m.
Monday, July 2 ..	Bacchus Marsh	1 p.m. ..	12.34 p.m. ..	Driving
Monday, July 2 ..	Melton ..	3 p.m. ...	Driving ..	8.50 p.m.
Tuesday, July 3 ..	Riddell ..	11 a.m. ..	8.13 a.m. ..	2.46 p.m.
No. 8.				
Monday, July 9 ..	Mitiamo (Railway Station)	1.37 p.m.	1.37 p.m. ..	1.53 p.m.
Monday, July 9 ..	Pyramid (Railway Station)	2.30 p.m...	2.30 p.m. ..	7.10 a.m. (10th)
Tuesday, July 10 ..	Raywood ..	11 a.m. ..	9.18 a.m. ..	12.50 p.m.
Tuesday, July 10 ..	Tandarra ..	1.5 p.m. ..	1.4 p.m. ..	4.42 p.m.
Wednesday, July 11..	Bendigo ..	10 a.m. ..	6.10 p.m. (10th)	12.12 p.m.
Wednesday, July 11..	Marong ..	1 p.m. ..	12.41 p.m. ..	5.13 p.m.
Thursday, July 12 ..	Maldon ..	11.45 a.m.	11.37 a.m. ..	Driving
Thursday, July 12 ..	Shelbourne ..	1.30 p.m...	Driving ..	Driving
Thursday, July 12 ..	Castlemaine	3.40 p.m...	3.40 p.m. ..	8.38 p.m.
Friday, July 13 ..	Newstead ..	10.30 a.m.	9.12 p.m. (12th)	11.31 a.m.
No. 9.				
Monday, July 9 ..	Rupanyup (Railway Station)	4.40 p.m...	4.40 p.m. ..	5.5 p.m.
Tuesday, July 10 ..	Marnoo ..	9.30 a.m.	6.25 p.m. (9th)..	11 a.m.
Tuesday, July 10 ..	Lubeck (Railway Station)	1.20 p.m.	1.20 p.m. ..	1.30 p.m.
Tuesday, July 10 ..	Ararat ..	3.45 p.m...	3 30 p.m. ..	8 36 a.m. (11th)
Tuesday, July 11 ..	Stawell ..	10 a.m. ..	9.25 a.m. ..	2.34 p.m.
Thursday, July 12 ..	Avoca ..	9 30 a.m.	8.20 a.m. ..	Driving
Thursday, July 12 ..	Navarre ..	11.30 a m.	Driving ..	Driving
No. 10.				
Monday, July 9 ..	Macorna ..	3 p.m. ..	2.55 p.m. ..	9.17 p.m.
Tuesday, July 10 ..	Koondrook..	9.30 a.m...	Driving ..	Driving
Tuesday, July 10 ..	Kerang ..	2 p.m. ..	Noon	3.55 p.m.
Wednesday, July 11..	Nyah ..	9 a.m. ..	Driving ..	Driving
Wednesday, July 11..	Piangil ..	9.30 a.m.	Driving ..	Driving
Wednesday, July 11..	Manangatang	11 a m. ..	Driving ..	Driving
Wednesday, July 11..	Chillingollah	Noon ..	Driving ..	Driving
Wednesday, July 11 ..	Ultima ..	3 p.m. ..	Driving ..	Driving
Wednesday, July 11..	Lalbert ..	4 p.m. ..	Driving ..	Driving
Thursday, July 12 ..	Swan Hill ..	10 a.m. ..	Driving (11th) ..	12 noon

STALLION PARADES, TIME TABLE—*continued.*

No. and Date.	Parade.	Time.	Officer Arrives.	Officer Departs.
No. 11.				
Monday, July 16 ..	Royal Show Grounds	10 a.m.		
No. 12.				
Monday, July 23 ..	Tungamah ..	1.30 p.m...	1.21 p.m. ..	3.21 p.m.
Monday, July 23 ..	Devenish ..	4 p.m. ..	4 p.m. ..	8.37 p.m.
Tuesday, July 24 ..	Yarrawonga	11 a.m. ..	10 p.m. (23rd) ..	2.45 p.m.
Wednesday, July 25..	Benalla ..	9 30 a.m.	5 10 p.m. (24th)	11.25 a.m.
Wednesday, July 25	Rutherglen	2 p.m. ..	1.53 p.m. ..	7.50 a.m. (26th)
Thursday, July 26 ..	Chiltern ..	2 p.m. ..	1.13 p.m. ..	3.45 p.m.
No. 13.				
Monday, July 23 ..	Tallángatta..	4 p.m. ..	3.53 p.m. ..	Driving (24th)
Tuesday, July 24 ..	Corryong ..	12.30 p.m.	Driving ..	6 a.m. (25th)
Wednesday, July 25..	Wodonga (Railway Station)	12.45 p.m.	12.45 p.m. ..	3.5 p.m.
No. 14.				
Wednesday, July 25..	Inglewood ..	11 a.m. ..	10.2 p m. (24th)	1.29 p.m.
Wednesday, July 25 ..	Boort ..	4.26 p.m...	4.26 p.m. ..	5 p.m.
Thursday, July 26 ..	Quambatook	10 a.m. ..	6.23 p.m. (25th)	11.5 a.m.
Thursday, July 26 ..	Korong Vale	2.32 p.m...	2.32 p.m. ..	3.25 p.m.
Friday, July 27 ..	Wedderburn Junction	2.8 p.m. ..	2.8 p.m. ..	3.39 p.m.
No. 15.				
Monday, July 30 ..	Kyabram ..	1.30 p.m...	12.32 p.m. ..	Driving
Monday, July 30 ..	Tongala ..	3 p.m. ..	Driving ..	4.12 p.m.
Tuesday, July 31 ..	Tatura ..	10.30 a.m.	5.30 p.m. (30th)	11.37 a.m.
Tuesday, July 31 ..	Echuca ..	1.45 p.m...	1.45 p.m. ..	3.45 p.m.
Tuesday, July 31 ..	Rochester ..	4.30 p.m...	4.25 p.m. ..	9.3 a.m. (1st)
Wednesday, August 1	Elmore ..	11 a.m. ..	9.40 a.m. ..	12.57 p.m.
Wednesday, August 1	Bamawm ..	3 p.m. ..	Driving ..	Driving
Thursday, August 2..	Gunbower ..	4 p.m. ..	4 p.m. ..	Driving
Friday, August 3 ..	Cohuna ..	11 a.m. ..	Driving ..	12.10 p.m.
No. 16.				
Monday, July 30 ..	Moyhu ..	2 p.m. ..	Driving ..	Driving
Monday, July 30 ..	Whitfield ..	4 p.m. ..	Driving ..	Driving
Tuesday, July 31 ..	Wangaratta	11 a.m. ..	Driving ..	12.39 p.m.
Tuesday, July 31 ..	Bright ..	4.7 p.m. ..	4.7 p.m. ..	6.4 a.m. (1st)
Wednesday, August 1	Myrtleford ..	2 p.m. ..	7.12 a.m. ..	7.12 a.m. (2nd)
Thursday, August 2..	Beechworth	11 a.m. ..	9.50 a.m. ..	12.51 p.m.
Thursday, August 2 ..	Everton ..	2 p.m. ..	1.11 p.m. ..	3.30 p.m.
Friday, August 3 ..	Euroa ..	10 a.m. ..	6.33 p.m. (2nd)..	11.10 a.m.
Friday, August 3 ..	Seymour ..	1 p.m. ..	12.8 p.m. ..	8.15 p.m.

STALLION PARADES, TIME TABLE—*continued.*

No. and Date.	Parade.	Time.	Officer Arrives.	Officer Departs.
No. 17.				
Monday, July 30 ..	Dookie (Railway Station)	12.48 p.m.	12.48 p.m. ..	1.3 p.m.
Monday, July 30 ..	Katamatite (Railway Station)	2.8 p.m. ..	2.8 p.m. ..	2.55 p.m.
Tuesday, July 31 ..	Nagambie (Railway Station)	9 a.m. ..	7.34 p.m. (30th)	9.59 a.m.
Tuesday, July 31 ..	Shepparton..	2 p.m. ..	11.18 a.m. ..	8.26 p.m.
Wednesday, August 1	Numurkah ..	11 a.m. ..	9.32 p.m. (31st)	12.38 p.m.
Wednesday, August 1	Strathmerton	1.10 p.m...	1.10 p.m. ..	1.20 p.m.
Wednesday, August 1	Cobram ..	2 p.m. ..	1.57 p.m. ..	3.10 p.m.
Thursday, August 2..	Nathalia ..	2 p.m. ..	1.37 p.m. ..	3.26 p.m.
Friday, August 3 ..	Murchison ..	10 a.m. ..	7.3 p.m. (2nd) ..	10.45 a.m.
Friday, August 3 ..	Rushworth..	11.48 a.m.	11.48 a.m. ..	12.25 p.m.
Friday, August 3 ..	Colbinabbin	1.30 p.m...	1.20 p.m.	2.30 p.m.
No. 18.				
Monday, August 6 ..	Heathcote ..	2 p.m. ..	11.30 a.m. ..	6.23 p.m.
Tuesday, August 7 ..	Alexandra ..	2 p.m. ..	12.30 p.m. ..	4.15 p.m.
Wednesday, August 8	Yea ..	9.30 a.m...	6.28 p.m. (7th)..	10.38 a.m.
Wednesday, August 8	Mansfield ..	2 p.m. ..	1.55 p.m. ..	3.30 p.m.
Thursday, August 9	Kilmore ..	9 a.m. ..	8.30 a.m. (driving)	9.40 a.m.
No. 19.				
Tuesday, August 7 ..	Casterton ..	11 a.m. ..	7.55 p.m. (6th)..	Driving
Tuesday, August 7 ..	Coleraine ..	3 p.m. ..	Driving ..	Driving
Wednesday, August 8	Edenhope ..	12 noon ..	Driving ..	Driving
Wednesday, August 8	Harrow ..	2 p.m. ..	Driving ..	Driving
Wednesday, August 8	Balmoral ..	3 p.m. ..	Driving ..	Driving
No. 20.				
Tuesday, August 7 ..	Dartmoor ..	11 a.m. ..	9 p.m. (6th) ..	9.55 a.m. (8th)
Wednesday, August 8	Heywood ..	11.45 a.m.	11.45 a.m. ..	12.15 p.m.
Wednesday, August 8	Portland ..	1.30 p.m...	1.5 p.m. ..	8.30 a.m. (9th)
Thursday, August 9	Branxholme	11.15 a.m.	11.15 a.m. ..	11.52 a.m.
Thursday, August 9	Dunkeld ..	1.30 p.m...	1.30 p.m. ..	3.53 p.m.
Thursday, August 9..	Hamilton ..	4.33 p.m...	4.33 p.m. ..	Driving (10th)
Friday, August 10 ..	Cavendish ..	10 a.m. ..	Driving ..	Driving
No. 21.				
Monday, August 13 ..	Dean's Marsh	11.35 a.m.	11.35 a.m. ..	2.40 p.m.
Monday, August 13 ..	Birregurra ..	3.5 p.m. ..	3.5 p.m. ..	7.55 p.m.
Tuesday, August 14 ..	Colac ..	10 a.m. ..	8.22 p.m. (13th)	11.15 a.m.
Tuesday, August 14 ..	Gellibrand (Railway Station)	12.54 p.m.	12.54 p.m. ..	Continues journey by same train
Tuesday, August 14 ..	Beech Forest	2.30 p.m...	2.30 p.m. ..	3.10 p.m.
Wednesday, August 15	Laver's Hill	10 a.m. ..	5.20 p.m. (14th)	12.10 p.m.
Thursday, August 16	Winchelsea..	10 a.m. ..	7.51 p.m. (15th)	11.10 a.m.

STALLION PARADES, TIME TABLE—*continued.*

No. and Date.	Parade.	Time.	Officer Arrives.	Officer Departs.
No. 22.				
Monday, August 13 ..	Beaufort ..	2 p.m. ..	12.35 p.m. ..	6.40 p.m.
Tuesday, August 14..	Willaura ..	10 a.m. ..	8.15 a.m. ..	2.19 p.m.
Tuesday, August 14 ..	Maroona ..	2.45 p.m...	2.45 p.m. ..	3.15 p.m.
Wednesday, August 15	Nhill ..	3 p.m. ..	1.31 a.m. ..	1.32 a.m. (16th)
No. 23.				
Monday, August 13 ..	Port Fairy ..	4 p.m. ..	3.36 p.m. ..	5.42 a.m. (14th)
Tuesday, August 14 ..	Koroit ..	11 a.m. ..	6.25 a.m. ..	Driving
Tuesday, August 14..	Hawkesdale	2 p.m. ..	Driving ..	3.27 p.m.
Tuesday, August 14 ..	Penshurst ..	4.11 p.m...	4.11 p.m. ..	7.32 a.m. (15th)
Wednesday, August 15	Warrnambool (Railway Station)	10.15 a.m.	10.15 a.m. ..	10.55 a.m.
Wednesday, August 15	Terang ..	12.30 p.m.	12.5 p.m. ..	1.30 p.m.
Wednesday, August 15	Mortlake ..	2.5 p.m. ..	2.5 p.m. ..	Driving
Thursday, August 16	Camperdown	11 a.m. ..	5.35 p.m. (15th)	12.25 p.m.
Thursday, August 16	Timboon ..	2.10 p.m...	2.10 p.m. ..	2.55 p.m.
Thursday, August 16	Cobden ..	3.55 p.m...	3.55 p.m. ..	Driving
Friday, August 17 ..	Werribee ..	11.47 a.m.	11.47 a.m. ..	1.16 p.m.
No. 24.				
Monday, August 20 ..	Drysdale ..	11 a.m. ..	9.35 a.m. ..	4.6 p.m.
Tuesday, August 21 ..	Meredith ..	10 a.m. ..	9.42 a.m. ..	11.13 a.m.
Tuesday, August 21 ..	Bannockburn	2 p.m. ..	11.38 a.m. ..	4.23 p.m.
Wednesday, August 22	Lismore ..	12 noon ..	11.55 a.m. ..	Driving
Wednesday, August 22	Vite Vite ..	2 p.m. ..	Driving ..	4 52 p.m.
Thursday, August 23	Cressy ..	10.30 a.m.	6.12 p.m. (22nd)	11.5 a.m.
Thursday, August 23	Westmere ..	2 p.m. ..	1.17 p.m. ..	4.7 p.m.
Friday, August 24 ..	Inverleigh ..	10 a.m. ..	9.53 a.m. ..	Driving
Friday, August 24 ..	Geelong ..	2 p.m. ..	12.10 p.m. ..	5.55 p.m.
No. 25.				
Monday, August 20 ..	Daylesford ..	Noon ..	11.59 a.m. ..	2.25 p m.
Tuesday, August 21 ..	Waubra ..	10 a m. ..	Driving ..	Driving
Tuesday, August 21 ..	Linton ..	2 p.m. ..	Driving ..	Driving
Tuesday, August 21 ..	Skipton ..	3 p.m. ..	Driving ..	Driving
Wednesday, August 22	Clunes ..	11 a.m. ..	8.50 a.m. ..	1.43 p.m.
Wednesday, August 22	Creswick ..	2.30 p.m...	2.16 p.m. ..	Driving
Wednesday, August 22	Kingston ..	3 30 p.m...	Driving ..	6.13 p.m.
Thursday, August 23..	Kyneton ..	10 a.m. ..	9.10 a.m. ..	Driving
Thursday, August 23..	Redesdale ..	2 p.m. ..	Driving ..	Driving
No. 26.				
Monday, August 20 ..	Morwell (Railway Station)	11.57 a.m.	11.57 a.m. ..	12.15 p.m.
Monday, August 20 ..	North Mirboo	3 p.m. ..	1.50 p.m. ..	4.15 p.m.
Tuesday, August 21..	Traralgon ..	10 a.m. ..	9.2 p m. (20th)	12.20 p.m.
Tuesday, August 21 ..	Sale ..	2 p m. ..	1.26 p m. ..	6 20 a m. (22nd)
Wednesday, August 22	Maffra ..	9 a.m. ..	7.14 a.m. ..	11.8 a.m.
Wednesday, August 22	Cowwarr ..	2 p.m. ..	1.15 p.m. ..	5.1 p.m.
Thursday, August 23	Trafalgar ..	10 a.m. ..	6.51 p.m. (22nd)	11.16 a.m.
Thursday, August 23..	Moe ..	Noon ..	11.31 a.m. ..	6.39 p.m.

STALLION PARADES, TIME TABLE—*continued.*

No. and Date.	Parade.	Time.	Officer Arrives.	Officer Departs.
No. 27.				
Monday, August 27 ..	Warragul ..	10.12 a.m.	10.12 a.m. ..	11.5 a.m.
Monday, August 27 ..	Neerim South	3 p.m. ..	12.20 p.m. ..	5.30 p.m.
Tuesday, August 28 ..	Bunyip ..	10 a.m. ..	9.38 a.m. ..	11.25 a.m.
Tuesday, August 28 ..	Pakenham ..	12 noon ..	11.54 a.m. ..	Driving
Tuesday, August 28 ..	Berwick ..	3 p.m. ..	Driving ..	9.19 p.m.
Wednesday, August 29	Cranbourne..	11 a.m. ..	8.2 a.m. ..	6.16 p.m.
Thursday, August 30	Woolamai ..	9.30 a.m...	8.35 p.m. (29th)	10.8 a.m.
Thursday, August 30	Wonthaggi ..	2 p.m. ..	10.55 a.m. ..	4 p.m.
Friday, August 31 ..	Lang Lang ..	9.15 a.m...	6.16 p.m. (30th)	9.53 a.m.
Friday, August 31 ..	Dandenong..	11.30 a.m.	11.20 a.m. ..	12.39 p.m.
No. 28.				
Monday, August 27 ..	Korumburra	10.30 a.m.	10.27 a.m. ..	Driving
Monday, August 27 ..	Leongatha ..	2.30 p.m...	Driving ..	11.3 a.m. (28th)
Tuesday, August 28 ..	Yarram ..	3.30 p.m...	3.10 p.m. ..	11.35 a.m. (29th)
Wednesday, August 29	Welshpool ..	2 p.m. ..	12.59 p.m. ...	12.59 p.m. (30th)
Thursday, August 30	Foster ..	2.1 p.m. ..	2.1 p.m. ..	2.21 p.m.
Friday, August 31 ..	Stony Creek	Noon ..	11.40 a.m. ..	3.19 p.m.
No. 29.				
Tuesday, August 28 ..	Mernda ..	11 a.m. ..	9.50 a.m. ..	1.36 p.m.
Tuesday, August 28 ..	Whittlesea ..	2.30 p.m...	2 p.m. ..	7.55 p.m.
Wednesday, August 29	Lilydale ..	2 p.m. ..	1.53 p.m. ..	5.25 p.m.
Thursday, August 30	Ballarat ..	11.30 a.m.	11.8 a.m. ..	3 p.m.
Friday, August 31 ..	Romsey ..	11 a.m. ..	10.40 a.m. ..	Driving
No. 30.				
Monday, September 3	Dromana ..	1.30 p.m...	1 p.m. ..	2.20 p.m.
Tuesday, September 4	Cowes ..	1 p.m.		
Wednesday, Sept. 5 ..	Stony Point	11 a.m. ..	11 a.m. ..	11.30 a.m.
Wednesday, Sept. 5 ..	Frankston ..	2 p.m. ..	12.26 p.m. ..	5.52 p.m.
No 31.				
Tuesday, September 4	Orbost ..	10 a.m. ..	7.15 p.m. (3rd)	8.50 a.m. (5th)
Wednesday, Sept. 5 ..	Nowa Nowa	10.30 a.m.	10.14 a.m. ..	Driving
Wednesday, Sept. 5 ..	Buchan ..	Noon ..	Driving ..	Driving
Thursday, September 6	Bairnsdale ..	Noon ..	11.20 a.m. ..	Driving
Thursday, September 6	Lindenow ..	3.4 p.m. ..	Driving ..	3 p.m.
No. 32.				
Tuesday, September 4	Omeo ..	3 p.m. ..	3 p.m. ..	5.30 a.m. (5th)
Wednesday, September 5	Bruthen ..	3 p.m. ..	11.45 a.m. ..	9.45 a.m. (6th)
No. 33.				
Wednesday, September 19	Sunbury ..	11 a.m. ..	7.41 a.m. ..	3.6 p.m.
	French Island			
No. 34.				
Wednesday, September 19	Royal Show	1.30 p.m.		
Thursday, September 20	Royal Show	9 a.m.		

CITRUS FRUIT EXPORT.

Results of Experimental Shipments.

By S. A. Cock, Citriculturist, Department of Agriculture.

Can Australia Compete with South Africa?

For the purpose of exporting to oversea markets the citrus-growers of this State early in 1922 combined into district associations, and with the Murray border districts of New South Wales grouped up under an organization called the "Victorian Central Citrus Association." The Murrumbidgee areas of Griffith and Leeton in New South Wales also shipped through this central association, their oranges being placed on ship at Sydney.

This oversea export marks a distinct advance in the citrus industry, and the following extract from the *Age* of the 19th February, 1923, gives an idea of what is thought of Victorian oranges by our rivals:—

Australian Oranges.

SOUTH AFRICA ADMITS THEIR SUPERIORITY.

Australian oranges reach Great Britain in the English summer. Their most formidable competitor is the orange from South Africa. Proof of the statement made that Australian oranges are superior to those from South Africa is contained in a report by Mr. Canahan, the South African Trade Commissioner. He states:—The arrival in fairly large quantities of Australian oranges has not unnaturally created a standard of comparison, and it is not pleasant to be told on almost every hand that South African oranges are inferior in quality, in appearance, and even in packing to those from the sister Dominions. But I am afraid that we must admit that fact. Higher prices are undoubtedly being obtained for Australian fruit. Our shippers enjoy substantial advantages both as regards rates of freight and longer experience of the trade, and it should not be difficult to place on the market fruit from the Union which will be equal to, if not excel anything that may be brought into competition with it. It means constant supervision, as well as the elimination of everything calculated to lower our reputation. The success of a pack in the main is made in the packing house. This responsibility cannot be placed on the inspector at the port, valuable as this work undoubtedly is, and unless the packer himself takes a pride in his business, and ships only the best stuffs, we cannot expect the highest results. This is cheering information when the packing of many Australian products exported overseas is so frequently criticised as faulty."

Where Our Citrus Industry can be Improved.

Of course, this comment is very gratifying, but at the same time it conveys to us a useful message. And the message is: That South Africa is not going to remain idle, but will immediately seek to remedy

the defects that have been made so apparent in their citrus industry. The shipment, which aroused the admiration of the South African Trade Commissioner, was Victoria's initial effort in citrus export, and we, consequently, have all the more reason to congratulate ourselves. We must not, however, be carried away by any compliments paid us. There are many defects to remedy, difficulties to overcome, and as far as South Africa is concerned, keener competition to combat. Growers should, therefore, give earnest and serious consideration to the following important phases in citrus culture.

1. Elimination of Unsuitable Varieties and working over with varieties proved for quality, both of rind and pulp. This applies more particularly to the Navel orange, and the elimination of the Navalencia and Thompson's Improved is strongly urged, on account of the variability of their citric qualities, which through the differences of soil and climatic conditions render these varieties too uncertain as a commercial proposition. Unfortunately in the past many of these trees were sold as Washington Navels, and growers have now to face the arduous task of overworking these, and also other off-type Navels (the result of indiscriminate bud selection by nurserymen) with buds from trees which have proved themselves, and are producing the correct type of Washington Navels.

2. Growers have also to recognise that large fruit is not required either for Local or Export Market. This brings under consideration the question of intelligent cultivation, manuring and irrigation, all of which, separately and conjointly, are of the utmost importance in relation to the quality of the rind and pulp of the orange. The free use of nitrogenous manures, whilst stimulating the growth of the trees, is inclined to produce large rough fruit. Potash and phosphate manures, on the other hand, are required to improve the quality of the rind and pulp of the fruit. What the grower requires to consider is that citrus culture is an individual tree proposition. He should, therefore, strive to find out the trees' requirements, and endeavour to adjust the balance between steady growth and quality fruit. Again, light sandy soils, sandy loams, and heavy soils produce different quality fruits, even in similar varieties; hence the study of the food requirements of the tree is of the utmost importance.

By the Grouping of the Growers into Associations much good should result. It has been suggested to each association that it should study the conditions which obtain in each district, and by experiment and comparison strive to overcome cultural difficulties. Our fruit has won a good name overseas, and we must endeavour to heighten that reputation, not only as regards quality, but also as regards standard. To that end it is proposed to establish packing sheds in every district grouped as an association. These sheds will be adjacent to the railway, and will be thoroughly equipped for the purposes of grading and packing. It would also be of a great advantage if a standardized grading machine were used in every shed. In almost every district where a standardized grader was used with this season's crop, most of the fruit sent overseas arrived in good condition, while in the fruit from places where various types of grades were used or hard-grading resorted to, much loss was reported. The

following statement of the various shipments with the reports forwarded by the Agent-General for Victoria will indicate to the districts the importance of correct grading:—

DISTRICTS FORWARDING ORANGES AND INSURANCE ADJUSTMENTS.

District.	Number of Cases.	Insurance Adjustments.		
		Number of Cases Paid on.	Average Amount Paid per Case.	Percentage on District Consignments.
			s. d.	
Mildura	374	181	5 3	48
Irymple	2,501	1,488	6 10	60
Merbein	3,564	1,502	6 0	42
Curlwaa	2,127	1,123	4 3	53
Nyah	1,304	523	3 1	40
Riverside	463	81	4 2	17
Tresco	1,980	902	3 6	46
Swan Hill	167	64	3 7	38
Picola	187	85	4 7	45
Cobram	1,010	752	6 3	74
Shepparton	617	109	4 7	18
Bemawm	918	163	2 4	18
Echuca	292	100	4 0	34
Kyabram	650	242	2 9	37
Perricoota	214	106	1 9	49
Griffith, N.S.W.	1,959	877	6 0	45
Dennys, Lascelles	380	156	2 9	41
Total	18,707	8,454	5 1	45

Wastage in Fruit Exported.

The average amount paid per case is given for the purpose of indicating the amount of wastage shown in the consignments, and is based on the net amount received by the growers. The percentage averages on the district consignment indicate the number of cases containing wasty fruit, and is no indication of the total average waste of the consignment. This can be arrived at only by a knowledge of the fact, whether growers had to bear the first 10 per cent. of waste, or whether payment was made on the total waste. Apparently, as far as can be judged, the payment is on the total wastage. Taking the sum received for the full shipment by the Victorian Central Citrus Association, excluding Dennys, Lascelles, but including Griffith, New South Wales, at £14,900 gross, London, and taking the amount of the insurance at £2,300 gross, it would indicate that the amount of wasty fruit was approximately 13½ per cent. for the total consignment. The amount of insurance paid by the Central Association amounts to approximately 2s. 4d. per case, and represents a sum of £2,000, so that shippers will be well advised in future to pay proper attention to the quality of the fruit forwarded to make sure of proper grading and packing, and to insure only against total loss or breakdown of the refrigerating machine, or what is known as F.B.A. insurance.

The amount realized for a shipment by Dennys, Lascelles per the *Demosthenes* has not been supplied; consequently the figures given in

the case of this firm are for shipments forwarded by the *Barrabool* and *Beltana* only.

SUMMARY.

Shipment.	Number of Consignors.	Number of Cases.	Credits, as per Account Sale.	Debits, as per Account Sales.	Percentage of Debits against Debits and Credits	Insurance Claims.				
						Number of Consignors claiming.	Number of Cases paid on.	Amount paid (net).	Average Amount per Case.	Percentage on Total Shipment.
								£ s. d.	s. d.	
Moreton Bay .. .. Sailed, 14.6.22; started to discharge London, 25.7.22	137	3,451	134	3	2	30	160	110 15 7	13 10	4½
Ascanius .. .. Sailed, 1.7.22; London, 24.8.22	168	3,647	141	27	16	162	2,267	625 19 6	5 6	62
Kent .. .. Sailed, Sydney, 5.7.22; London, 1.9.22	35	752	8	27	77	31	402	127 15 3	6 4	53
Barrabool .. .. Sailed, 7.7.22; London, 28.8.22	141	2,808	84	57	40	116	1,351	436 0 8	6 5	48
Beltana .. .. Sailed, 24.7.22; London, 20·9·22	169	4,479	40	120	71	163	2,815	473 18 1	3 4	63
Demosthenes .. .. Sailed, 3 8.22; London, 16.9.22 (excluding Dennys, Lascelles)	159	3,570	28	131	82	146	1,459	390 7 4	5 4	41
	809	18,707	444	365	44	648	8,454	2,164 16 5	5 1	45

Lessons from the Experiment.

By taking the debits in the above summary and placing them against the total debits and credits it might seem that there is a steady increase in the deterioration as the season advances. This may be so, as the fruit from early districts was fully ripe, as compared with that from the later ones, and the summary shows that the later districts have had less wastage than the earlier.

Again, there is no evidence as to the best route for our fruit, as only one boat, the *Moreton Bay*, went *viâ* Suez, all the later boats going *viâ* the Cape. With such insufficient data it is scarcely fair to make comparisons. After the *Moreton Bay*, three shipments were made in the experimental chambers of the Commonwealth Line. The loss on only two of the shipments can be given, no figures for the *Hobson's Bay* shipment having come to hand. The loss on account of wastage on the fruit sent by the *Esperance Bay* and *Largs Bay* was 10 and 33 per cent. respectively.

The thirty-three cases mentioned as lost in repacking citrus shipped on the *Largs Bay* may not all have taken place on the voyage. The fruit was for the Crystal Palace Show, and was removed to cool storage, and afterwards repacked for the show. Unfortunately, it is only in a comparison of the figures supplied and a perusal of the reports forwarded by the Agent-General that the faults of the shipment can be sought for. A reference to the average charges and percentages under the insurance claims show that the shipments varied in their wastage. Considering this fact with the debits and credits, and taking the difference as shown in averages and percentages for wastage, the want is revealed of a clear statement from London showing

on what average the insurance is paid. This would give a better idea of the actual wastage. It is suggested, therefore, that these matters be more clearly defined in future shipments.

In addition, allowance has to be made for the fact that there is no check on the carriage of the fruit under refrigeration, such as the number of times the chambers were opened to receive more cargo, the absence of long-distance thermometers, and also self-registering thermometers in the chamber itself. Therefore, the statement of the engineer has to be accepted.. In future consignments it is hoped these defects in the carriage of oversea refrigerated cargo will be removed.

The districts, however, will, I feel sure, read into this article the defects that are their own. Old districts, such as Irymple, Merbein, Curlwaa, and Cobram must realize that they have suffered by comparison with the younger districts of the State, and they must realize that to be successful, standard-grading machines, properly equipped packing sheds, and care and attention in cultural methods, and also in picking and handling, are necessary factors for successful export.

Taking everything into consideration, and realizing the fact that this was the initial effort of Victoria in citrus export, there is no reason to be ashamed. The watchword of the citrus-grower should be, "Combine, co-operate, organize, standardize, utilize knowledge, improve production and presentation." The sum of 18s. 6d. per case charges this season does not leave much margin for the shipper, but it is hoped that next season 12s. 6d. per case will cover all charges. This should result in a reasonable return for all oranges exported.

EXPERIMENTAL SHIPMENTS.

Shipments.	Districts contributing.	Number of Cases	Remarks.
Largs Bay.. .. Sailed, 9.8.22; London, 28.9.22	Mildura .. Irymple Curlwaa Riverside Tresco Swan Hill Shepparton Bamawm Perricoota Griffith, N.S.W.	95	33 cases lost in repacking. 38 cases sold at 27s. 6d. per case. Insurance recovery, 4 cases at 16s. 9d. each. 24 cases for Crystal Palace Show. Result of Exhibit.—2nd prize, silver medal and £10 cash to Griffith, N.S.W.; 3rd prize, bronze medal and £5 cash to V.C.C.A., made up of six cases from the following districts:—Merbein, Curlwaa, Swan Hill, Bamawm, and Shepparton; 1st prize, gold medal and £20 cash was won by E. G. Wood, Riverside, who shipped through Dennys, Lascelles
Hobson's Bay .. Sailed, 6.9.22	Tresco ..	85	Realized in London £102 18s.
Esperance Bay .. Sailed, 6.10.22; London, 13.11.22	Irymple .. Kyabram .. Perricoota .. Griffith, N.S.W.	90	Valencia Late.—Realized from 35s. to 45s. per case. Loss in repacking 7½ cases, ; returned £154 19s.
	Bamawm .. Tresco .. Madowla ..	56	Washington Navel.—Realized from 40s. to 50s. per case. Loss in repacking 7¼ cases, ; returned £114 1s. 3d.

Another experimental shipment was forwarded on the *Hobson's Bay.* This is referred to in the report of the Agent-General.

The absence of detailed statements regarding these experimental shipments is not satisfactory, and in future it is proposed that full details should be supplied for the guidance of shippers. The value of experiments cannot be over-estimated, not only as to carrying quality of the fruit, but also for the purpose of proving markets. Apparently there is a market for Valencia Late and Navels in October and November. This is the time when supplies are short from South Africa, and the Mediterranean fruit has not been placed on the market. Shippers, however, will be well advised to again prove these months before shipping in large quantities. If it can be proved a large market exists at this time, there is no doubt that we can supply it with Navels from the heavy soils and late districts, and with Valencias from both early and late districts. Contemporary with these overseas shipments experiments have been carried out in cool storage at the Government Cool Stores under the supervision of Mr. D. B. Adam, B. Ag. Sc., cool storage experimentalist. The results of his investigation, which are of the greatest importance to citrus-growers, are printed on pages 307-317.

REPORTS ON SHIPMENTS BY THE AGENT-GENERAL, THE HON. JOHN McWHAE.

Shipment per s.s. "Moreton Bay."

London, 27th July, 1922.

This vessel started to discharge on 25th inst. The temperatures at which the Victorian fruit was carried are as follows:—

Melbourne to Adelaide, 43° Fahr.
Melbourne to Fremantle, 41° Fahr.
Melbourne to Colombo, 40° Fahr.
Melbourne to Port Said, 40° Fahr.

And within four days of arriving in London the temperature was raised from 40° to 55° Fahr. The oranges arrived in excellent condition, and Mr. F. White, of the Agent-General's Department, states: "On inspecting the hold, I found that great care had been taken in the storage of the fruit. The space between each layer of boxes was 2 inches and over, which enabled the air to circulate freely. In discharging, several boxes were broken in halves. This could be prevented by a wire band at each end, similar to South African boxes."

Experimental Shipment.

Carried at a temperature of 38° to 42° Fahr. in experimental chamber, average 40°.

Tresco.—Twenty-eight cases of Washington Navels. Half in hardwood cases and half in softwood cases. Half of consignment sweated and half not sweated. No difference noticed either as regards cases or sweated and non-sweated fruit. Prices realized—

1 case, 70's, at 20s.
16 cases, 96's, at 20s.
10 cases, 126's, at 21s.
1 case, 150's, at 22s. 6d.

Curlwaa.—Ten cases Thompson's Improved in softwood cases. Prices realized—

4 cases, 64's, at 20s.
4 cases, 80's, at 20s.
4 cases, 112's, at 21s.

Merbein.—Four cases Washington Navels in softwood cases, vaselined after sweating. Prices realized—

1 case, 80's, at 20s.
1 case, 96's, at 21s.
2 cases, 150's, at 21s.

Fifteen cases Jaffas in softwood cases. Prices realized—

1 case at 24s.
1 case at 23s.
3 cases at 22s.
1 case at 21s.
7 cases at 20s.

Two cases to ship's officers.

Ten cases of mandarins in softwood cases. Half Beauty of Glen Retreat and half Emperor mandarins. Prices realized—

2 cases at 27s. 6d. } Beauty of Glen Retreat.
3 cases at 40s. }
4 cases at 25s. } Emperor.
1 case at 24s. }

No reason given as to difference in price obtained for these varieties.

Irymple.—Eleven cases of Navelencia oranges in softwood cases carried in general shipment of oranges. Prices realized—

4 cases, 96's, at 20s.
1 case, 96's, at 20s.
4 cases, 112's, at 20s.
2 cases, 176's, at 22s.

Further Report on the Victorian Oranges ex s.s, "Moreton Bay."

Boxes.—These were very nice, clean and of good size and attractive appearance. I almost think that the box was too good, as it looks as if it cost quite a considerable amount. The box that the South African trade is using could, at the present time, be delivered c.i.f. Melbourne for 1s. 2d. It is a good box, and will be quite suitable for the Australian trade. It does not affect the price of the oranges whether packed in hardwood or softwood cases with iron hoops at each end. I would suggest that the cheapest should be used, so as to reduce the price of the case.

The branding of the box was liked; some buyers suggested that the name of the grower should be on.

Packing.—This was distinctly good, except for one district, the "Irymple." I noticed very little fruit was damaged in the picking, but some cases were not full enough, the buyers liking to see, when a case is open, very little space left between the lid and the fruit.

Quality.—This was generally good. Some of the larger oranges were on the coarse side, and the run of the fruit was too large. The

popular sizes here are from 176 to 250 oranges to the case, and sizes such as 64, 80, 96, and 112 oranges to the case are difficult to sell, and make less money.

Wrapping Paper.—Many of the oranges were not completely wrapped, the paper being too small to contain the fruit. If no larger size is available two pieces should be used. The trade is not generally in favour of the grease-proof paper. It was tried in South Africa and also in Spain, and both these countries dropped it some years ago. The market is still experimenting, but as far as can be ascertained, they have not succeeded in producing a grease-proof paper that carried fruit as well as a porous paper. The trade experience in importing fruit has been that the paper should be absorbent. Grease-proof paper does not allow the fruit to evaporate; in fact, it causes the evaporation to settle on the paper and the fruit in the form of moisture, which naturally must have a harmful effect on any fruit which is being carried under refrigeration.

Many customers complain that the grease-proof paper holds the dust, thereby making the fruit look stale when on sale in shops.

The market and also the shopkeepers prefer the paper branded, as they consider it gives the fruit a more attractive appearance.

The design of the kangaroo at present used on the paper wrappers is quite good. I would suggest that if the whole of the design was of a purple colour, it would show up better against the golden colour of the fruit.

Condition of Fruit.—With the exception of one district (Irymple) the condition was good. The fruit from Irymple was rather poor, not graded well, and contained too many oranges bearing tree marks. The fruit grown under irrigation naturally will not stand very long, and there was a distinct change noticeable in a week after the fruit came out of cold store. The market considers that the shipment from the Merbein district was in the correct condition. The boat shipment generally appeared to be on the ripe side. With regard to the fruit carried in the experimental chamber, there was very little difference between this and the bulk of the shipment, except that it was somewhat firmer.

Prices.—These were naturally not high, due to the following reasons:—

1. The oranges generally were too large.
2. Over 13,000 South African oranges arrived the same week, and the bulk of same were small fruit.
3. The boat arrived just before August Bank Holiday, which meant that unless the fruit was sold within the week, it would have to be held over the holidays and brought into a dead week. No fruit of this description is wanted between the Wednesday before a holiday and a week after.
4. Big crops of English plums, apples, French William pears, and greengages being on the market.

Victorian oranges are fetching the following prices:—

200 to 252 oranges to the case, 24s. to 25s. per case.
126 to 176 oranges to the case, 22s. to 23s. per case.
96 to 112 oranges to the case, 20s. per case.
68 to 80 oranges to the case, 18s. to 20s. per case.

Mandarins.—We do not recommend exporting these except in very small quantities, this being a fruit that can only sell in the winter months when there are no soft fruits against it. The few cases of Victorian mandarins consigned fetched from 25s. to 30s. per case, one or two cases 40s. per case, which is quite an exceptional price, and might not be obtained if larger quantities were consigned.

Shipment per s.s. "Ascanius."

London, 5th September, 1922.

This vessel started to discharge her oranges on 24th August. The fruit was carried at a temperature of 36 deg. to 44 deg. Fahr., average 40 deg. The engineer started to raise the temperature within six days from Hull. Between each layer of boxes was 1 inch of wood, and in the centre was 3 inches to allow of good ventilation.

The condition of the fruit by this boat was fair only, quite a number of cases marked B.B. (Merbein) and B.C. (Irymple) contained five or six bad oranges—practically pulp. This may have been caused by the packers overlooking bruised fruit, or placing wet fruit in the grease-proof paper, which does not allow evaporation. The best marks were B.H. (Tresco), B.F. (Nyah), B.E. (Riverside); B.B. and B.C. were the worst. The remarks made in my report on oranges *ex* s.s. *Barrabool* with regard to grading, packing, and paper shavings used apply also to this shipment. The prices realized on landing—25th August—were 20s. to 22s., with a tendency downward. Prices realized on 5th September 16s. to 18s. Market weak.

London is considered the best market for oranges, and the men on the market consider that the proportion between the three ports should be as follows:—

London, 60 per cent.
Liverpool, 25 per cent.
Hull, 15 per cent.

I mention this, as next season too large a quantity may be consigned to Hull as the result of the good prices realized for the South Australian oranges *ex* s.s. *Ascanius* at that port. The market here consider that the Washington Navel oranges coming from Victoria are superior to those coming from South Africa, and they have nothing to fear from them, and can stand on their own merits on this market.

Further Report on Shipment of Oranges per s.s. "Ascanius."

As previously reported the fruit on the above boat arrived only in a fairly satisfactory condition. The following information is supplied for guidance of shippers:—

B.A. (Mildura).—Fruit nicely graded and well coloured, but skins a little too coarse in some cases.

B.B. (Merbein).—Practically the same remarks apply as for B.A.

B.C. (Irymple).—Badly graded fruit; coarse skins and black eye (Botrytis); a good deal of waste. This mark has been the worst on each boat.

B.D. (Curlwaa)
B.E. (Riverside)
B.F. (Nyah)
} Fruit of fair quality, but showing waste.

B.H. (Tresco).—Fruit of good quality; well graded. The best mark of the shipment.

B.O. (Cobram).—Fruit nicely coloured, but very light in weight; skins rather thick; grading poor.

Shipment per s.s. "Barrabool."

London, 7th September, 1922.

The above vessel started to discharge on 28th August, and the cases I saw opened were in good condition. The temperature at which the fruit was carried was from 37 deg. to 41 deg. Fahr. Between each layer of boxes there was 1 inch of wood and in the centre of the pack 3 inches to allow of good ventilation. There were a number of cases broken in handling, and as suggested previously, a wire band at each end of the case would save these breakages.

Badly graded fruit.—B.B. (Merbein) 1,101 contained 96 oranges to the case, and would have taken 112 if properly packed and graded. The same applies to B.B. 1,100. In fact, in many cases more oranges could have been packed to the case with proper grading.

B.J. 1,681 (Bamawm).—One hundred and twenty-six oranges to the case. This case was graded and packed correctly, and had five layers of fruit, which gave the appearance of a good full case when opened.

Lisbon lemons marked B.E. (Riverside).—A large number of these were badly marked, and nearly all had moisture showing on them, owing to the grease-proof paper, which does not allow of evaporation. The fruit will not pay to send here, as there are plenty of Continental lemons on the market. Messina lemons, 300 to the box, selling at 6s. to 12s.; Murcia lemons, 300 to the box, at 10s. to 14s.; Navies, 300 to the box, 8s. to 12s. according to quality.

There is no use in using paper shavings, as they are of no benefit to the oranges, and make the case unsightly with the strips of paper coming through the sides of the case. The hardwood cases are a success, being much stronger than the softwood, and I have no doubt would be cheaper, and the hardwood case makes no difference to the selling price of the oranges.

Prices realized on 29th August, 20s. to 22s. Prices realized on 5th September, 16s. to 20s. Market weak.

Shipment per s.s. "Beltana."

London, 3rd October, 1922.

This vessel started to discharge her oranges on the 20th September at King George V. Dock. The temperature at which the fruit was carried was 38 deg. to 40 deg. Fahr. The stowage of the fruit had 1 inch battens between each layer and between each layer 3 x 3-inch battens. The general turnout was fair; a large number of cases contained fruit showing dry waste and blue mould.

Messrs. G. Monro forwarded 3,000 cases to Hull and 1,500 cases to Liverpool owing to s.s. *Beltana* and *Demosthenes* coming in together.

also 15,000 cases arriving from the Cape the same week. Liverpool reports say they consider the dry waste and blue mould is caused by insufficient air to the oranges. I would, therefore, suggest that a consignment be sent with the battens on the cases 1 inch apart, and that absorbent tissue paper be used for wrapping the oranges, and no shavings or packing of any kind used.

Cases marked B.O. (Cobram), B.B. (Merbein), B.E. (Riverside), B.C. (Irymple) had from ten to twelve bad oranges to the case, and some forty to fifty bad oranges; a few had only ten to twelve sound oranges.

Prices realized at Hull and Liverpool, 13s. 6d. to 20s., and at London, 14s. to 18s.

Shipment per s.s. "Demosthenes."

London, 3rd October, 1922.

The above boat started to discharge her oranges at King George V. Dock on 16th September. The temperature at which the fruit was carried was 38 deg. to 42 deg. Fahr. Three-eights of an inch battens were used between each layer of boxes in the hold. There were a number of broken cases, and, as suggested before, wire bands would prevent this. Cases marked B.O. (Cobram) were discharged in a pulp condition, the juice running from the cases in the sheds at the dock. The fruit arrived in wasty condition, and the following cases were condemned by the sanitary authorities:—

B.O. (Cobram), twenty-nine cases.
B.H. (Tresco), four cases.
B.M. (Shepparton), one case.
B.K. (Kyabram), one case.

Cases marked B.C. (Irymple) were very poor indeed, and showed signs of going bad at the start. B.D. (Curlwaa) were wasty, and fetched in some cases 5s. per case.

B.M. (Shepparton), and B.P. (Perricoota).—Good fruit; bad condition.

B.O. (Cobram).—Fruit good colour; bad weight; coarse skin and wasty on arrival.

B.E. (Riverside)
B.Q. (Echuca)
B.D. (Curlwaa)
B.F. (Nyah)
} Fruit good colour; good quality; also slightly wasty on arrival.

The unreliability of condition manifested itself very rapidly throughout the boat, making it increasingly difficult to cultivate the trade in its favour as a fancy fruit. Prices realized 14s. to 18s. A number of cases lost in repacking.

Further Report on Shipment per s.s. "Demosthenes."

Messrs. Geo. Monro Ltd. informs me that this is the worst lot of oranges we have received. Not only was the fruit very bad, but the cases were wet and badly stained. This fact alone is enough to

cause a bad impression amongst the trade, and combined with the large amount of waste make it difficult to dispose of the fruit at any price.

B.C. (Irymple).—Badly graded and packed, black eyes (Botrytis) was very prevalent, and considerable waste showing.

B.M. (Shepparton).—This fruit was well packed and nicely graded, but unfortunately a wasty condition prevented satisfactory prices being obtained.

B.P. (Perricoota).—There was very little to choose between this mark and B.M.

B.H. (Tresco).—This fruit appears to have been very good when picked, but arrived showing 50 per cent. of waste.

B.O. (Cobram).—Very wasty indeed; the worst mark on the boat. No. 1845 was particularly bad, no less than twenty-six cases being condemned by the food authorities.

B.K. (Kyabram).—Nice fruit of good colour, but wasty.

C mark (New South Wales).—Fruit of good quality, but showing nearly 50 per cent. waste.

C 2048 (New South Wales).—Two cases of grape fruit. These were very common fruit, of bad colour and very light weight. The fruit does not compare at all favorably with the Jamaica grape fruit, and further shipments are not recommended.

Agent-General's Comments on Insurance Charges.

London, 14th November, 1922.

With reference to the insurance charge of 2s., this large amount is caused by insuring against deterioration of the oranges on the boat. This lends itself to fraud, as there have been instances where bad fruit has been shipped, which it would have been useless to ship if Lloyd's insurance had not covered for this, and at the same time it is unfair to those growers who are consigning good fruit to the market. This item of 2s. could be reduced to 2d. if there was no insurance against deterioration, and I would, therefore, suggest that it be done away with; while there should also be every endeavour made to get a reduction of 2s. per standard case of oranges, making it 5s. 6d. so as to enable growers to establish a market here on a profitable basis.

Shipment on s.s. "Largs Bay."

London, 3rd October, 1922.

Started to discharge on 18th September. Carried at a temperature of 37 deg. to 40 deg. Fahr. 1½-inch battens between each layer of cases, with a fan working in a special chamber. This fruit was shipped in the experimental chamber, and after discharging from ship was placed in cool storage prior to opening of *Daily Mail* Show. There were some very fine Washington Navel oranges amongst this consignment. They were of medium size, 176 to the case, clean and sound. This is the class of orange required on this market. If consignments similar to these were consigned they would be worth to-day from 25s. to 30s. per case on a bad market.

(The prizes awarded the fruit are given in the remarks on shipments. The Agent-General had the boxes of prize fruit displayed, together with the medals awarded in *The Strand.* He also forwarded a case from the first prize lot to the Queen. He states: "This is the best way to reply to the astounding statement made by one of the members of the Board of Trade, who is on the executive committee of the British Empire Exhibition, that South African oranges were the only ones fit to consume in the Exhibition.")

The Agent-General further states:—"The oranges grown by E. G. Wood, of Riverside, Victoria, are the kind of Washington Navel oranges required on this market, and if consignments are sent similar to these they will command the highest price. The best selling prices are from 150 to 200. Small sizes carry the best. The best packing material is wood wool, but no packing material is necessary in the case of oranges. Messrs. Geo. Mouro Ltd. considers that grease-proof paper is injurious to all fruit, and strongly recommends that its use be discontinued; they mentioned that one consignment of 200 cases arrived this season packed in non-grease-proof paper, and there was not a bad orange in the lot."

Shipment on s.s. "Hobson's Bay."

London, 1st November, 1922.

Temperatures at which oranges on the above boat were carried are as follows:—Chamber temperature on receiving fruit at Melbourne, 46 deg. Fahr., and was reduced to 40 deg. and 41 deg. Fahr. for remainder of voyage until passing Gibraltar, when the temperature was allowed to rise gradually to atmospheric temperatures. Some of the oranges were wasty, but owing to a shortage on the market they made very good prices, viz., 26s. to 30s. per case.

Shipment on s.s. "Esperance Bay."

London, 15th November, 1922.

This vessel started to discharge her oranges on 13th inst. The chief engineer informed me that he carried them at a temperature of 38 deg. to 42 deg. Fahr. Some of the oranges were good, others wasty. The Valencias averaged thirty wasty to the case containing 250. Case marked B.C. 1197 (Newton Brothers, Irymple) contained some very fine Valencias, the colour being first class.

B.J. (Bamawm), 1,690; half bad.
B.J. (Bamawm), 1,611; 25 per cent. bad.
B.J. (Bamawm), 1,609; 33 per cent. bad.
B.J. (Bamawm), 1,591; 15 per cent. bad.
B.J. (Bamawm), 1,638;; 20 per cent. bad.

All bad and wasty fruits were repacked. The market being very short of this fruit, they are realizing for Navels 40s. to 45s., and Valencias 35s. to 40s. per case.

South African Oranges Sold in London.

The following figures relating to the quantities of oranges shipped from South Africa to England and the prices obtained for same during portion of last year have been supplied by the Agent-General:—

Week ending—		No. of Cases.	Price per Case.
			s. d. *s. d.*
June	10	762	30 0 to 35 0
	17	1,415	25 0 to 30 0
	24	6,445	25 0
July	1	9,480	16 0 to 18 0
	8	5,113	18 0 to 20 0
	15	22,000	18 0 to 20 0
	22	23,911	18 0 to 20 0
	29	28,488	20 0 to 22 6
August	6	7,445	22 0 to 24 0
	12	34,493	22 0 to 24 0
	19	17,768	24 0 to 25 0
	26	21,211	18 0 to 26 0
September	2	16,632	18 0 to 24 0
	9	8,644	16 0 to 18 0
	16	17,193	14 0 to 18 0
	23	18,848	16 0 to 18 0
	30	10,023	16 0 to 18 0
October	7	8,850	18 0 to 20 0
	14	2,948	20 0 to 22 0
	21	14,030	23 0 to 26 0
Total	.. .. ..	275,699	

EXPERIMENTS IN CITRUS FRUIT STORAGE.

D. B. Adam, B. Agr. Sc., Department of Agriculture.

These experiments have been conducted rather on the lines of the hard fruit experiments, where a determination of the losses under different conditions of storage was made, than as an experiment to demonstrate the economic possibilities of cool storage. In this latter instance, the life in store is determined more by the condition and prospects of the market than the actual condition of the fruit. A study of the factors limiting the "storage life" of citrus fruits involves, however, quite different problems from those considered under the headings of apple and pear storage. Losses in citrus fruit which may be ascribed to physiological causes are small, practically the whole loss with these varieties of fruit is due to fungus attack, particularly from the so-called "mould fungi."

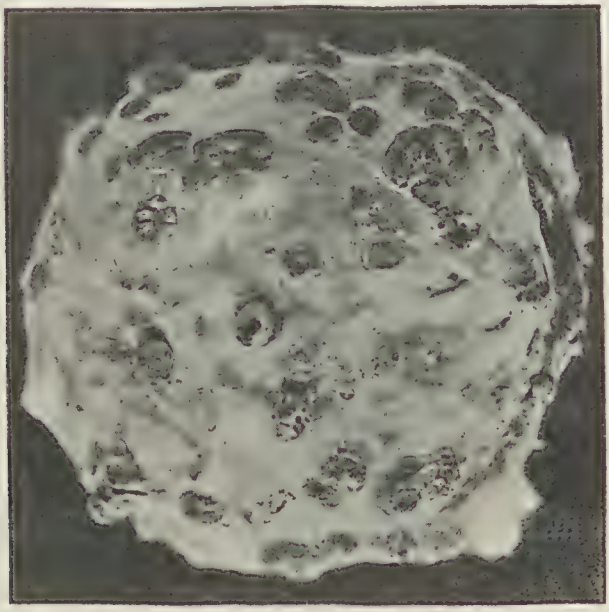
Thus conditions affecting the growth of moulds generally determine the cool "storage life" of citrus fruits.

Orange Storage.

Washington Navel oranges grown at Ballendella, Tongala, Tresco, Riverside, and Late Valencias grown at Barham, have been stored under

experimental conditions. This has enabled tests as to the effects of storage at different temperatures, the use of different kinds of wrapping papers, and "sweating" on the keeping qualities of oranges, to be performed. The keeping qualities of fruit from the different districts packed in both hard and soft wood cases can also be compared.

The following species of fungi were isolated from oranges in cool store:—*Penicillium digitatum* (*Fr.*) Sacc.; *Penicillium italicum* Wehmer; *Botrytis cinerea*, Pers.; *Sclerotinia libertiana*, Fekl.: *Alternaria citri*, Ellis and Pierce; *Pythiacystis citriopthora* Sm. and Sm., *Dematiam pullulans* De Bary; *Cladosporium sp.* Generally, *P. digitatum*, the olive-green mould, is the cause of most of the wastage in orange



Orange affected by the Cottony Mould, *Sclerotinia libertiana* after some period in cool store.

storage. In some particular instances *Botrytis cinerea*, the grey mould, caused the greatest amount of loss. *Botrytis* infection frequently commences around the stalk button which is left on the fruit; hence the name "Black eye" is given to oranges so affected. Areas affected by *Botrytis* become soft, affording a good stratum for other fungi to develop. In such areas *P. italicum* occurred much more frequently than did *P. digitatum*. The amount of loss from fungi other than from these three mentioned was small and localized. The presence of the diseases Brown Rot, due to the fungus *Pythiacystis citriopthora*, and the Cottony Mould, due to *Sclerotinia libertiana*, should be noted. The possible serious consequences of these diseases in storage problems, as shown by experience elsewhere, demand that they should receive attention in the grove, where, according to the best known methods of control, it is necessary to practise prevention methods.

The Experimental Results.

(1) The Effect of Temperature of Storage on Mould Development.

Fruit has been stored at 32° F., 34° F., 37° F., and 39°-40° F. The figures given below give the percentage affected at the different temperatures irrespective of the extent of its development on individual fruits. The numbers of oranges examined in each consignment, at each temperature, vary from 70 to over 300.

Only oranges that were treated as uniformly as possible in other respects, being neither wrapped nor "sweated," were compared. The results are given in Table 1.

Table 1.

District.	Variety.	Storage Period, in Days.	Temperature Per Cent. Mould at—			
			32° F.	34° F.	37° F.	39-40° F.
Riverside ..	(*a*) Washington Navel	96	1	8·1	No figures	12·3
,, ..	(*b*) ,,	90	No figures	6·6	5·1	10·3
Tresco ..	,,	94	7·1	7·6	24·6	26·2
Tongala ..	,,	108	11·2	No figures	47·3	47·9
Barham ..	Late Valencia	106	0·7	1·6	5·0	5·4
Average..	..	..	5·0	10·6	20·2	20·5

Figures for wrapped and "sweated" fruit showed the same comparative wastage at different temperatures, though the variations were much smaller. The incompleteness of series treated uniformly in other respects, however, precludes their presentation as experimental evidence. The results clearly illustrate the benefits of low temperatures in orange storage. The difference in waste in fruit stored between 40° F. and 37° F. and between 37° F. and 34° F. is worthy of particular notice. Apparently, the inhibition of mould growth for each degree below 37° F. is much greater than is the increase in development for each degree above 37° F.; 37° F. is a critical temperature for these mould fungi. Nothing has been said of the composition of the mould flora. This varied; *Botrytis cinerea*, the grey mould, affected over 60% of the wasty oranges in the Tongala consignment. In the other consignments *P. digitatum* was the fungus present on the majority of wasty fruits. The percentage mould appears to decrease approximately uniformly with temperature, irrespective of the actual causal agent. 32° F. gives the most satisfactory results from a purely freedom from mould standpoint. At 32° F., however, under certain conditions "spotting" and "blotching" may occur. This objection to storage at 32° F. is discussed later under the heading of "spotting" on oranges.

In view of this consideration and the difficulty of maintenance of precise temperature in practical cool storage management a temperature of 34° F. is recommended.

(2) The Use of Different Kinds of Wrapping Papers.

Oranges grown and stored under different conditions have been tested as to their keeping qualities when wrapped with waxed papers similar to those used in last year's shipments overseas, with the ordinary sulphite tissue papers, and when not wrapped.

Table II. gives a comparison of the results of the use of these papers with Washington Navel oranges from Tresco stored at two different temperatures.

Table II.

Temperature.	Waxed Wrappers.			Tissue Wrappers.			Unwrapped.		
	Sound.	Mould.	Per Cent. Sound.	Sound.	Mould.	Per Cent. Sound.	Sound.	Mould.	Per Cent. Sound.
34° F.	94	22	81	104	8	93	149	16	90
37° F.	112	42	71	136	26	84	124	47	72

Table III. gives similar results in respect to fruit from Ballendella at three different temperatures.

Table III.

Temperature.	Tissue Wrappers.		Waxed Wrappers.		Unwrapped.	
	Number Examined.	Per Cent. Sound.	Numbers Examined.	Per Cent. Sound.	Numbers Examined.	Per Cent. Sound.
32° F. ..	216	90	196	39	134	76
37° F. ..	No figures	..	188	23	178	60
40° F. ..	,,	..	216	16	180	54

None of the oranges referred to in either table was sweated. Both tables show significant results in favour of the use of the ordinary tissue wrapping papers. The extent of the infection is not shown. In those wrapped in waxed papers frequently more than one area on the orange was affected, particularly in the Tresco fruit, where many areas were first infected by *Botrytis cinerea* followed by infection with one of the species of *Penicillium*.

In seeking a reason for the difference of results between the use of waxed and tissue wrappers, we find that the waxed wrapper retains the moisture transpired by the fruit. In store, in some cases beads of moisture may be observed inside the wrapper; this produces a high relative humidity in contact with the rind. It is a well-known fact that fungi, particularly the mould fungi, thrive in humid atmosphere. On the other hand, the tissue wrapper both on account of its dryness and porosity does not allow high relative humidities to be attained in the neighbourhood of the rind. Fruit that has been wrapped in tissue wrappers is much brighter in appearance than fruit which has been wrapped in waxed papers, an effect which may be ascribed to favorable humidity conditions about the fruit.

(3) The "Sweating" of Oranges.

The term "sweating" is applied to the process of removing portion of the moisture from the rind or oranges. Generally, this is accom-

plished by spreading out on a shelf immediately after picking. The period may vary from three days to a fortnight.

A study of this process on the keeping qualities of oranges has been made.

Table IV. gives the results of orange storage for twelve weeks with fruit from Riverside. Some of the fruit was sweated in the orchard for a fortnight before storage; these are compared with fruit treated similarly in other respects, but which were not sweated. No wrapping papers were used.

Table IV.

(*a*) "sweated," (*b*) not "sweated."

Chamber Number.	Temperature. Degrees F.	Refrigerating System.	Sound.	Mould.	Per Cent.
3 (*a*) ..	34	Direct Expansion	96	0	100
(*b*) ..			65	16	80
4 (*a*) ..	34	Air Circulation	120	0	100
(*b*) ..			96	1	99
5 (*a*) ..	34	Direct Expansion and Air Circulation	75	0	100
(*b*) ..			103	2	98
6 (*a*) ..	37	" " " "	100	1	99
(*b*) ..			76	4	95
7 (*a*) ..	37	Direct Expansion	168	0	100
(*b*) ..			75	9	89
8 (*a*) ..	37	Air Circulation	140	0	100
(*b*) ..			90	0	100
22 (*a*) ..	40	" "	384	12	97
(*b*) ..			388	44	93

The results give evidence in favour of "sweating." It may be noticed that the fruit stored in the direct expansion chamber gave the highest percentage of mould for that temperature. Further results of "sweating" are given with fruit from Tresco in Table V.

Table V.—Washington Navel Oranges from Tresco.

Chamber.	Temperature. Degrees F.	Refrigerating System.	Sound.	Mould.	Per Cent. Sound.
No. 22 (*a*) sweated ..	40	Air Circulation ..	63	9	87
(*b*) not sweated ..	40	" " ..	78	28	74
7 (*a*) sweated ..	37	Direct expansion	67	3	95
(*b*) not sweated ..	..	" "	57	34	63

The value of "sweating" is well shown with this consignment.

The oranges from Tongala, as remarked previously, were subject to considerable loss from *Botrytis* infection. It is interesting to study the effect of "sweating" on the variety of mould flora. This comparison is made in Table VI.

TABLE VI.—WASHINGTON NAVEL ORANGES FROM TONGALA.

Showing the effect of "sweating" on the prevalence of the different species of mould. Both chambers are the air circulation type. (*a*) "sweated" for seven days, (*b*) not "sweated."

Chamber.	Temperature.	Numbers Examined.	Numbers showing—			Per Cent. Sound.
			Botrytis.	*Penicillium* following *Botrytis.*	*Penicillium.*	
8 (*a*) sweated	37° F. ..	164	1	0	4	94
(*b*) not sweated	..	218	20	0	11	71
22 (*a*)	40° F. ..	150	2	1	2	93
(*b*)	..	210	10	20	17	61

While demonstrating the value of "sweating," these results show that particularly good benefits will accrue from "sweating" in a district where *Botrytis* is prevalent on the trees, and is likely to cause damage to the fruit.

In order to study the use of a well-ventilated chamber for orange storage, several cases were stored in a long, cool passage, the temperature of which varied from 44° F. to 50° F., and the relative humidity from 76% to 95% averaged 79%. The fruit was examined after four weeks, and then removed to the experimental chambers to be examined eight weeks later, together with fruit that had remained in each of the experimental chambers for the whole period. The result of the analysis of the causes of wastage is given in Table VII.

TABLE VII.—WASHINGTON NAVEL ORANGES FROM TONGALA.

A comparison between oranges stored in a ventilated passage for four weeks and then stored at different temperatures with "unsweated," continuously stored fruit; none of the fruit was wrapped.

	40° F.		37° F.		34° F.		Averages.	
	Passage.	Ordinary Storage.	Passage.	Ordinary Storage.	Passage.	Ordinary Storage.	Passage.	Ordinary Storage.
Nos. examined ..	83	83	89	107	92	98	..	..
Penicilliums ..	33	15	48	6	6	4	29	8
Botrytis ..	2	6	1	44	5	15	3	22
Botrytis followed by *Penicillium*	0	16	0	12	1	16	0	14
Per cent. sound ..	58	56	46	42	87	64	64	54

Of the *Penicilliums*, *P. digitatum* (the olive-green mould) was the most common species, especially in the fruit from the passage-way, where 90% of the wasted oranges were so affected. *P. italicum* (the blue-green mould) is the commonest species following a *Botrytis* infection.

From a study of Tables VI. and VII. it is suggested that:—

(1) The relative humidity of the air is in immediate contact with oranges in a case serves as the limiting factor in the extent of the development of *Botrytis cinerea* on oranges. The relative

humidity is governed both by the moisture content of the rind, which, of course, is varied in the process of "sweating" and by the relative humidity of the air in the chamber.

(2) The temperature of the fruit and air in contact with the fruit serves as the limiting factor in the extent of the development of the citrus-rotting species of *Penicilliums* on oranges in cool store.

Grey mould, *Botrytis cinerea*, Pers., produces lesions on the wood of citrus trees. Last year is the first year that this disease was reported as

Washington Navel Oranges affected by *Botrytis cinerea*, after eight weeks' cool storage, showing how the disease may spread in a case of "unsweated" oranges.

attacking the fruit. In cool storage its habit of growth makes it a serious disease to contend with. Here the mycelium, the vegetable portion of the fungus which is not noticed in twig infections, grows to infect other oranges in cases where they are not wrapped. An illustration of this growth in a case of oranges is given. When the fruit is wrapped in waxed papers, this mode of spreading does not occur.

In view of the size of the spores and the millions produced, the chances of many spores alighting on each fruit of affected trees, or even where the other trees in a grove are affected, are considerable. Under favorable conditions each spore may grow, giving many points of infection.

It cannot be definitely stated whether an injury to the rind is necessary or not to produce the disease. If it is necessary, a very slight injury, which cannot be avoided in handling fruit, is sufficient.

Botrytis is very destructive to the rind, and spreads rapidly over it. It, however, does not penetrate the fruit to the same extent as the *Penicilliums* do.

The stalk end of the fruit is the commonest seat of infection, particularly if the fruit has not been "sweated" properly. The appearance of such oranges is described as "black eyed."

Some oranges which had been "sweated" lost the small stalk portion or button which is usually left on when the orange is removed from the tree. None of such oranges developed a "black eye," whereas other oranges which had been "sweated" for less lengthy periods, and which retained the buttons well, developed "black eye."

In districts where there is a possibility that *Botrytis* may develop on the fruit, it is recommended that oranges be "sweated" till the button is easily removed by hand, but not for so long that the buttons drop off of their own accord. A fortnight is about the maximum period that will be required under the usual conditions prevailing during the picking season.

If the stalk ends become detached or are left too long, they may cause injury to other fruit in the case. Several instances of infection about the navel in Washington Navel oranges were observed; these proved to be due to injury from the stalk end of the orange immediately above the affected fruits.

It is difficult to compare the keeping qualities of oranges from different districts with such small consignments as were used in the experiments. So many factors other than the one under review enter in; it is not easy to distinguish and estimate the relative effects of each of these variables. The figures set out in Table VIII. may be of some service for comparative purposes.

TABLE VIII.

District.	Variety.	Stored at—				Age of Trees.	Main Cause of Loss.	Period Stored, in Days.	Remarks.
		32°	34°	37°	39°-40°				
Ballendella	W.N.O.	76	60	..	36	6	*Penicilliums*	97	..
Riverside (1)	..	99	92	..	875	...	,,	96	..
Riverside (2)	..	..	94	95	90	..	,,	90	"Spotted."
Tongala ..	..	89	87	53	52	6	*Botrytis* ..	108	..
Tresco ..	..	93	92	75	73	8	*Botrytis and Penicilliums*	94	
Barham ..	Late Val.	99	98	95	95	8	,,	106	"Spotted."

Of the Washington Navel oranges, the Riverside consignments stand out the most favorably. The weather at Riverside was much drier than at Tresco. In a period of about ten weeks only 90 points of rain fell. At Tresco in the same period about 5 inches fell. Riverside fruit was grown on grey Murray silt; the Tresco fruit on a red sandy hillside.

Late Valencia oranges store better than Washington Navel oranges. This seems to be a feature of the respective powers of resistance of their rinds to the inroads of fungi. Some consignments were packed in soft-

wood cases, while others were packed in hardwood cases. As the consignments were drawn from different districts, it makes a comparison difficult; however, no effect which could definitely be referred to the particular type of case used was observed. The question as to the use of hardwood or softwood cases seems rather to involve questions of economy than of the relative keeping qualities of fruits in the different cases.

No special study has been made of handling methods. Since the "life" of oranges in store is determined to a large extent by certain mould fungi, most of which definitely require some injury to the rind before they can grow, the great importance of careful handling to prevent such injury is obvious. It is well to remember that even slight injury, a nail scratch, for instance, is a sufficient injury to allow a mould to develop. Too great care cannot be taken when handling the fruit which is intended for storing.

The "Spotting" or "Blotching" of Oranges.

A brown colouration of the rind, varying in its extent and regularity, sometimes occurs in oranges in cool store. Such discolourations may arise as the result of different causes. Included in this subject is the one determining factor in the cool storage of oranges of practical importance that is not due to any definite organism. Two causes of spotting or blotching are given, though these by no means exhaust the possibilities.

1. An infection by *Botrytis* which has for some reason become arrested; such areas are usually circular, small, dry, and slightly sunken. Oranges so affected are unsightly, and, although the disease will not spread on the removal of fruit from store, their sale is seriously affected.
2. Due to the injurious action of oils liberated from the rind.

That the oils liberated on injury of the rind of oranges caused "spotting" was suggested and studied by H. S. Fawcett.* A slight pressure is sufficient to press oil out of the surface glands of the rind in handling; this requisite pressure can hardly be avoided. Moisture in any form when present greatly extends the injurious effects. The moisture possibly carries the oil over larger areas, bringing about the more extensive injury. Unfortunately, no figures of the actual numbers affected were obtained. The following general observations help to confirm those made by Fawcett:—

1. More oranges were affected at 37° F. than at 32° F.
2. Oranges just picked and stored were affected worse than oranges that were "sweated" before storing.
3. Fruit picked and stored when moist "spot" badly.

Two consignments, previously referred to in different tables, were obtained from Riverside. Neither of these two consignments were "sweated," and both were treated as uniformly as possible, though one lot was forwarded six days before the other. The first was picked in clear, dry weather, the second in light and misty weather, although only about 12 points of rain fell during the interval between the respective forwardings.

* H. S. Fawcett, Bull. 266, Agr. Exp. Stn., Berk., Cal.

Figures elsewhere show that the keeping qualities of the fruit, judging from the amount of mould present, were similar. However, on sale the first lot returned more than twice the second lot. This difference was largely due to the presence of brown discolouration marks on many individuals in the second sample, whereas no spotting at all occurred on the oranges in the first consignment. These results demonstrate the necessity of picking and packing fruit when it is absolutely dry, to prevent its discolouration in store.

Since dryness is such an important factor in the prevention of spotting, some attention should be given to conditions in the cool store.

Some people report that too low a temperature with oranges causes "blotching," especially if the fruit is not wrapped. One of the most serious instances of spotting in the writer's knowledge was reported with oranges stored at a low temperature in a direct expansion chamber. In such a chamber, under actual commercial conditions, variations of two or three degrees of temperature are frequently recorded. The relative humidity in these chambers at 32° F. ranges from 90 to 100 per cent. Such variations of air temperature in the room cause deposition of thin films of moisture on the fruit. As results of experiments demonstrate that the existence and extent of "blotching" is affected to a considerable extent by moisture on the rind, we might expect a similar injurious action with these oranges, especially during the period immediately subsequent to their removal from store.

At higher temperatures, on the other hand, the relative humidity is lower, and the small variations of temperature may not be sufficient to allow appreciable quantities of moisture to condense; hence the absence of "blotching."

The foregoing may possibly serve in part as reason why low temperatures are not favoured by practical storemen when storing oranges.

Finally, it must be remembered that as most of the fruit was gathered in September, fairly late in the season, the conclusions necessarily apply more strictly to such later season fruit.

Summary and Conclusions.

1. 34° F. is recommended as a standard temperature of storage for oranges during the comparatively long period of carriage to Great Britain.

2. Comparisons in the use of different wrappers have been made. The sulphite tissue papers gave the most satisfactory results; in addition to being the freest from mould, such fruit was brighter and more attractive in appearance.

3. The importance of the process of "sweating" before storing has been indicated; "sweating" not only limits the development of fungi generally, but also affects the character of the flora.

4. The disease caused by *Botrytis cinerea* Pers. has been shown to be limited almost entirely in its extent by "sweating."

5. The time that it takes before the stalk end, or button, may easily be detached by hand has been suggested as an aproximate guide of the period for "sweating." The period varies from one to two weeks.

6. Late Valencia store better than do Washington Navel oranges.

7. On account of the operation of various factors outlined, it is difficult to state definitely a general "storage life" for oranges. Under the best set of conditions obtainable, fruit should be kept without undue loss for three months.

8. The "blotching" of oranges and its apparent relation to moisture has been considered. A theoretical reason for its appearance among oranges stored at low temperatures has been developed. The necessity for dry conditions, both while packing and in the cool store, in order to minimize "blotching," should be emphasized.

It is regretted that Part III. of the article on the Fruit Industry of Victoria has again had to be held over.

WEEDS AND THEIR ERADICATION.

By H. W. Davey, F.E.S., Orchard Supervision Branch, Department of Agriculture.

Nettle-leaved Goosefoot, *Chenopodium murale*, L. Family: *Chenopodiaceæ.*

The Nettle-leaved Goosefoot is a common and widely-spread annual (Fig. 62), and has on its young growth and inflorescence the mealy appearance common to many plants of this family.

It is a much-branched plant, and usually grows from eighteen to twenty inches high. The leaves are irregular in outline and toothed except towards their base, and rather fleshy and green on both sides, although occasionally some are mealy on the under-surface.

Persistent attention is required to keep it under control. When growing among cultivated crops it may be kept in check with the ordinary farm implements. In small gardens it can be hand-pulled before it reaches the flowering stage. Mowing the plants is of little use, as they soon put forth fresh stems. In places where they are plentiful, spraying them with arsenic would be a quick method of preventing seed production.

Stinking Goosefoot, *Chenopodium olidum.*

This most undesirable plant (Fig. 63) is probably better known under the specific name *Vulvaria*, L., which is a synonym. It can easily be recognised by its most horrible smell like that of putrid fish, and for this reason is often called the "fish plant." The fleshy leaves of the plant

are egg-shaped and have a triangular base; the flowers are in dense-clustered spikes, very mealy, and produce a great number of seeds.

Fig. 62.—Nettle-leaved Goosefoot, *Chenopodium murale,* L.

The same treatment as recommended for Nettle-leaved Goosefoot should be effective against this plant.

Fig. 63.—Stinking Goosefoot, *Chenopodium olidum*, C. Vulvaria L.

(To be continued.)

PLANTING AND RECONSTITUTION OF VINEYARDS.

Conditions Governing the Distribution of Phylloxera-Resistant Vine Rootlings and Cuttings.

The conditions subject to which Victorian vine-growers may purchase phylloxera-resistant vine cuttings and rootlings (grafted and ungrafted) from the State Vine Nursery, at Wahgunyah, have been drawn up for the current year, and copies of same are available on application.

Beyond certain alterations of dates the conditions are much the same as for last season. There is no alteration in price.

It has, however, been found necessary to modify the closing dates for receiving applications. The last dates before which these must be made have been advanced one month, they will thus be: for grafted rootlings (1924 delivery), 31st May, 1923; and for ungrafted rootlings and cuttings (1923 delivery), 30th June, 1923. After these dates applicants can only be supplied in the event of there being a surplus after all regular applications have been satisfied.

Applicants are required to finally decide, when filling in their application forms, as to their stock and scion requirements; no amendment can be permitted later.

It will suffice here to explain that resistant vines are supplied to intending planters in any of the following forms, and at the prices stated: packing extra in the case of consignments forwarded by rail:—

Resistant rootlings, grafted with scions previously supplied by applicants, at per 1,000, £12 (Deposit, 30s. per 1,000).

Resistant rootlings, ungrafted, at per 1,000, £3 (Deposit, 15s. per 1,000).

Resistant cuttings, at per 1,000, £1 10s.

Application Forms.

No application will be entertained unless made on the forms supplied for the purpose, which are obtainable from the Director, Department of Agriculture, Melbourne, or from the Manager, Viticultural Station, Rutherglen.

Separate forms are provided for (*a*) Grafted Rootlings; (*b*) Ungrafted Rootlings and Cuttings. Applications must be filled in on the proper forms, and accompanied by a deposit as specified above.

Each applicant for forms will be supplied with a copy of the detailed conditions governing the distribution of phylloxera-resistant vine rootlings (grafted and ungrafted) and cuttings.

Applicants are earnestly requested to thoroughly familiarize themselves with these. *They are warned that under no circumstances can any departure be permitted from the regulations governing the distribution as detailed therein, nor can any request for special consideration be entertained.*

Dates before which Applications must be made.

For Grafted Rootlings (1924 distribution, June to August inclusive), applications will be received until 31st May next. (For the 1923 distribution the time for receiving applications closed on the 30th June, 1922, and present applicants cannot be supplied until 1924.)

For Ungrafted Rootlings, to be distributed from July to August, 1923, inclusive, applications will be received until 30th June, 1923.

Applications for Cuttings will be received until 30th June, 1923.

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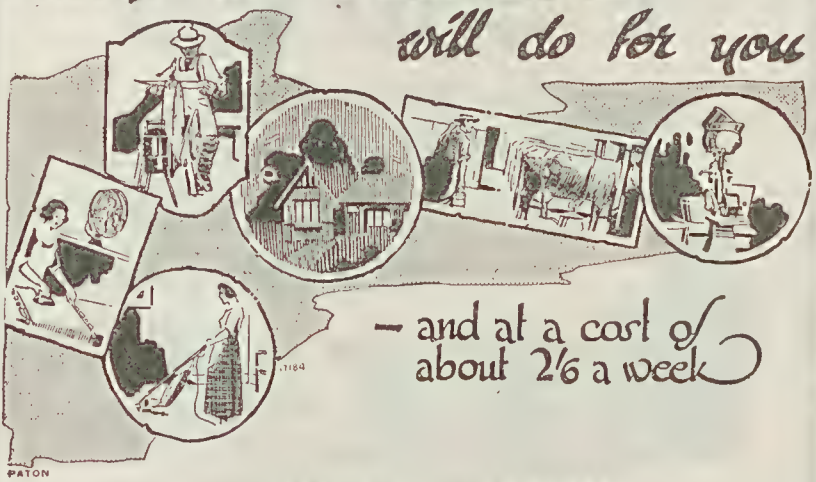

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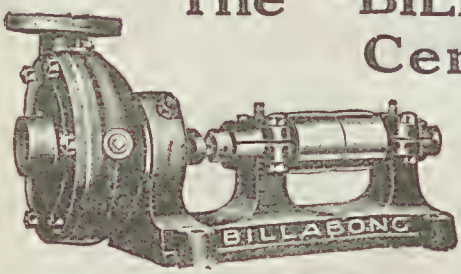

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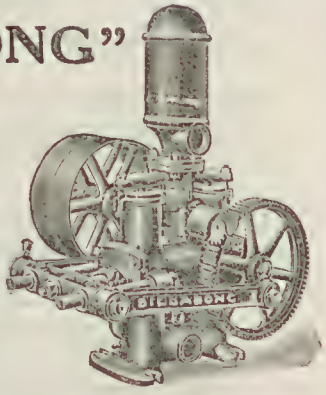

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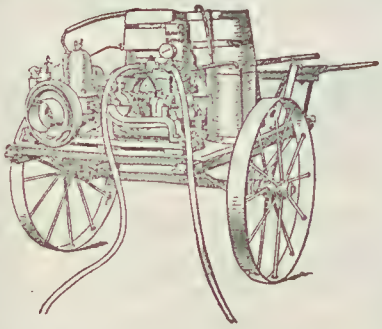

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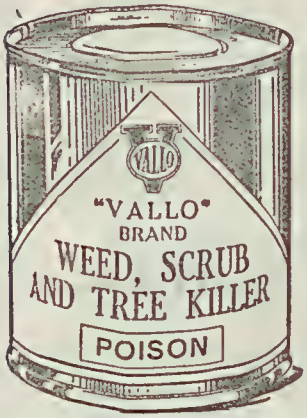

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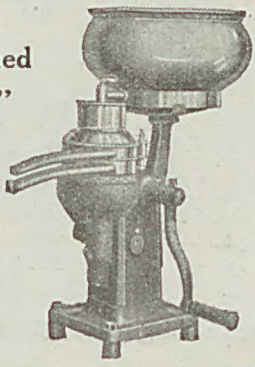

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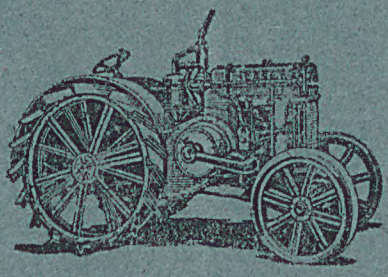

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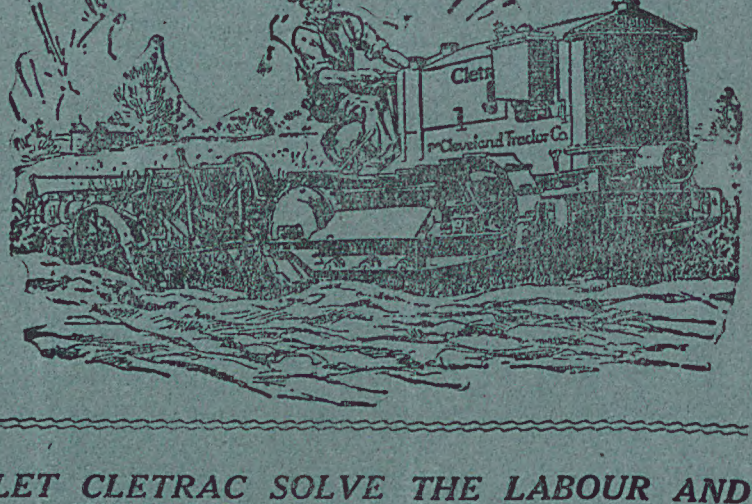

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